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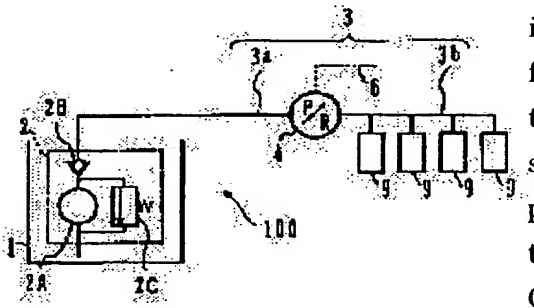
(54) FUEL SUPPLY DEVICE AND FUEL PRESSURE REGULATING VALVE

(57)Abstract:

PURPOSE: To dispense with a fuel return pipe and to reduce pressure fluctuation near a fuel injection valve by providing a fuel supply pipe with an inflow control type fuel pressure regulating valve for forcing fuel of the upstream side part to flow in the downstream side part to keep the downstream side pressure at a designated value when the pressure of the downstream side part is lowered than a designated value.



CONSTITUTION: A fuel supply device 100 comprises a pump device 2 including a tank 1, a pump 2A, a check valve 2B and a relief valve 2C, and a fuel injection valve 9 for injecting fuel introduced into a fuel supply pipe 3, wherein an inflow control type fuel pressure regulating valve 4 is disposed in the midway of the fuel supply pipe 3. The fuel pressure regulating valve 4 has a diaphragm for dividing the interior of a casing into a reference pressure chamber and a pressure regulating chamber, and a function of forcing fuel of an upstream side supply pipe 3a to flow in a downstream side supply pipe 3b to make the pressure of the downstream side supply pipe 3b larger than the reference pressure by designated differential pressure when a differential pressure between the pressure of the downstream side supply pipe 3b of the fuel supply pipe 3 and the reference pressure introduced through a reference pressure introducing pipe 6 becomes smaller than designated differential pressure.

[Claim(s)]
[Claim 1] Fuel pump equipment equipped with a discharge-pressure maintenance means to hold the fuel pump which pressurizes and carries out the regurgitation of the fuel in the fuel tank where a fuel is stored, and this fuel tank, and the discharge pressure of this fuel pump to the 1st predetermined value, At least one fuel injection valve which injects the fuel to which it connected with the downstream end of the fuel feeding pipe connected to said fuel pump equipment, and this fuel feeding pipe, respectively, and the upstream end was led from said fuel feeding pipe within [engine] inhalation of air, In the fuel supply system which has reference ******** which draws the reference pressure near the injection section of said fuel injection valve, and the fuel-pressure regulator valve which is connected to this reference ******** and adjusts the fuel pressure in said fuel feeding pipe While said fuel-pressure regulator valve is prepared on said fuel feeding pipe and holding the pressure of an upstream part from this fuel-pressure regulator valve to the 1st predetermined value among these fuel feeding pipes The fuel supply system with which the pressure of a downstream part is characterized by making the fuel of said upstream part flow into said downstream part when it becomes smaller than the 2nd predetermined value smaller than the 1st predetermined value, and holding the pressure of this downstream part to said 2nd predetermined value among [regulator valve / this / fuel-pressure] these fuel feeding pipes.
[Claim 2] Said fuel-pressure regulator valve is a fuel supply system characterized by holding so that the fuel of an upstream part may be made to flow into a downstream part and only said ****** to predetermined differential pressure may become large about the pressure of said downstream part, when the differential pressure of the pressure of a downstream part and said ****** becomes smaller than predetermined differential pressure from this fuel-pressure regulator valve among these fuel feeding pipes in a fuel supply system according to claim 1.
[Claim 3] It is the fuel supply system characterized by having further the check valve in which said fuel pump equipment permits only the flow from said fuel pump to said direction of a fuel feeding pipe in a fuel supply system according to claim 1.
[Claim 4] In a fuel supply system according to claim 1 said fuel-pressure regulator valve It is prepared so that casing and the interior of casing may be classified into a ****** room and a pressure regulation room, and it responds to the size of the pressure of said reference ******, and the pressure of said pressure regulation interior of a room. Deformable diaphram, Reference pressure-welding **** to which it is fixed to said ****** room side of said casing, and said reference ******** is connected, The pressure regulation fuel delivery where it is fixed to said pressure regulation room side of said casing, and a downstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The supply fuel end connection to which it is fixed to the pressure regulation room side of said casing, and an upstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The 1st hole which is formed in this supply fuel end connection, and opens this interior of a supply fuel end connection, and the exterior for free passage, It is arranged in said pressure regulation interior of a room, and deformation of said diaphram is embraced. A movable bulb movable in the deformation direction of this diaphram, The fuel supply system characterized by having the 2nd hole which will open said the 1st hole and said pressure regulation room for free passage if it is formed in this movable bulb and the differential pressure of the pressure of said pressure regulation interior of a room and the pressure of said reference ****** becomes small from said predetermined differential pressure.
[Claim 5] It is the fuel supply system characterized by having the relief valve connected by said discharge-pressure maintenance means branching from the discharge-side duct of said fuel pump in a fuel supply system according to claim 1.
[Claim 6] A pressure detection means to output the detecting signal which detects the pressure of an upstream part and corresponds from this fuel-pressure regulator valve among said fuel feeding pipes in a fuel supply system according to claim 1, It has further

a pump-control means to control the drive of this fuel pump to become the 3rd predetermined value which has the discharge pressure of said fuel pump in the larger range smaller than said 1st predetermined value and than said 2nd predetermined value according to said detecting signal. Said fuel-pressure regulator valve is a fuel supply system characterized by holding the pressure of an upstream part from this fuel-pressure regulator valve among said fuel feeding pipes at said 3rd predetermined value.

[Claim 7] In the fuel-pressure regulator valve which adjusts the fuel pressure in the fuel feeding pipe which is connected to reference ******** which draws the reference pressure near the injection section of the fuel injection valve which injects a fuel within [engine] inhalation of air, and leads a fuel to said fuel injection valve It is prepared so that casing and the interior of casing may be classified into a ****** room and a pressure regulation room, and it responds to the size of the pressure of said reference ******, and the pressure of said pressure regulation interior of a room. Deformable diaphram, Reference pressure-welding **** to which it is fixed to said ****** room side of said casing, and said reference ******** is connected, The pressure regulation fuel delivery where it is fixed to said pressure regulation room side of said casing, and a downstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The supply fuel end connection to which it is fixed to the pressure regulation room side of said casing, and an upstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The 1st hole which is formed in this supply fuel end connection, and opens this interior of a supply fuel end connection, and the exterior for free passage, It is arranged in said pressure regulation interior of a room, and deformation of said diaphram is embraced. A movable bulb movable in the deformation direction of this diaphram, The fuel pressure regulating valve characterized by having the 2nd hole which will open said the 1st hole and said pressure regulation room for free passage if it is formed in this movable bulb and the differential pressure of the pressure of said pressure regulation interior of a room and the pressure of said reference ****** becomes small from the 1st predetermined differential pressure.

[Claim 8] Said movable bulb is a fuel pressure regulating valve characterized by preparing a part of inner circumference [at least] in contact with the periphery of said supply fuel end connection in a fuel pressure regulating valve according to claim 7, and sliding on the shaft orientations of this supply fuel end connection according to deformation of said diaphram.

[Claim 9] The fuel pressure regulating valve characterized by having the spring with which it is arranged at said reference ******, and an end energizes this diaphram toward said pressure regulation fuel delivery side in a fuel pressure regulating valve according to claim 7 in contact with said diaphram by the energization force of magnitude equal to said 1st predetermined differential pressure.

[Claim 10] It is the fuel pressure regulating valve characterized by having the opening part which will open said the 1st hole and said pressure regulation room for free passage if the differential pressure of the pressure of said pressure regulation interior of a room [bulb / said / movable] and the pressure of said reference ****** becomes large in a fuel pressure regulating valve according to claim 7 from the 2nd bigger predetermined differential pressure than said 1st predetermined differential pressure.

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the fuel supply system equipped with the fuel-pressure regulator valve which adjusts the pressure of a fuel to the combustion chamber of an automobile engine especially with respect to the fuel supply system which supplies a fuel, and this fuel-pressure regulator valve.

[0002]

[Description of the Prior Art] Generally in the conventional automotive fuel feeder, the fuel pressure is adjusted using an overflow control form fuel-pressure regulator valve. As

a well-known technique about such a fuel supply system, there are the following, for example.

[0003] ** In the well-known technique of ******53-40105********, the fuel which came out of the pumping plant formed into the tank is led to the overflow control form fuel-pressure regulator valve connected to the serial through the fuel feeding pipe. The pressure of for example, the intake manifold collector section is led to the fuel-pressure regulator valve through reference ********, based on this pressure, it is controlled so that the differential pressure of the injection section pressure of a fuel injection valve and fuel pressure keeps it constant, and the overflow fuel for a surplus is returned to a tank through return tubing.

[0004] ** An overflow control form fuel-pressure regulator valve can be arranged near the tank while branching from a fuel feeding pipe and connecting with juxtaposition, and the well-known technique of ******47-13558******** omits substantially return tubing for returning an overflow fuel to a tank by this, reduces a tooth space and cost, and can constitute what is called a return loess method.

[0005] Moreover, there are the following as a well-known technique in which do not prepare a fuel-pressure regulator valve but other means adjust fuel pressure.

[0006] ** When the fuel control system which branched from the fuel feeding pipe and was connected to juxtaposition controls a halt and drive of pumping plant so that fuel pressure serves as a predetermined value, the well-known technique of the Patent Publication Heisei No. 500764 [two to] ****** omits return tubing, and realizes a return loess method.

[0007]

[Problem(s) to be Solved by the Invention] However, the following technical problems exist in the above-mentioned well-known technique. That is, in well-known technical **, since a fuel-pressure regulator valve will be arranged at the car-body anterior part in which an engine is carried and the tank was in the point empty vehicle object posterior part of safety reservation on the other hand, it was difficult for return tubing to which both are connected to make it huge, and to attain space-saving-izing and ** cost-ization.

[0008] Moreover, in well-known technical **, since pumping plant and a fuel-pressure regulator valve approach comparatively and are arranged, the die length of return tubing becomes very short (lost substantially), a return loess method can be realized, but since the die length becomes long in preparing reference ******** by one side, the effectiveness of return tubing shortening and simplification is reduced. Moreover, since the transfer lag of engine operational status arises, that the die length of reference ******** becomes long worsens operability and an exhaust gas condition at the time of operational status change. Furthermore, since the distance of a fuel-pressure regulator valve and a fuel injection valve becomes long by attaching a fuel-pressure regulator valve near the tank, fuel pressure fluctuation near the fuel injection valve becomes large, and highly precise fuel supply control becomes impossible. Moreover, also at the time of the temperature rise after an engine shutdown, since the injection-valve opening pressure of overflow is fixed, air bubbles are generated from a fuel and engine restart nature is worsened.

[0009] Furthermore, in well-known technical ** and **, pumping plant is always a whole-quantity discharge condition, and is a configuration through which the part which deducted the fuel flow injected from the fuel injection valve among the fuel flow sent out from this pumping plant circulates to a tank as an overflow flow rate from a fuel-pressure regulator valve. While it followed, for example, the flow rate loss of a fuel arose at the time of low r.p.m. operation, useless operation of a pump was not able to be controlled and reduction of consumption power was not able to be aimed at. Moreover, since the above-mentioned overflow flow rate becomes very large, for example at the time of idle operation and a tank circulating load increases, the fuel temperature rise in a tank may be caused. Therefore, the yield of a fuel vapor increases by this and the burden to the canister equipment for a fuel vapor cure becomes large. Moreover, although there

is also the approach of presuming from the control signal given to a fuel injection valve, controlling the supply voltage to the motor of pumping plant, and controlling the amount of sending out from pumping plant by this in order to lessen this fuel circulating load and to cancel a flow rate loss, the precision in control is inadequate. For this reason, it became the problem that a control unit became expensive.

[0010] Furthermore, in well-known technical **, are a fuel control system, and when fuel pressure becomes higher than the 1st pressure, a pump is suspended. Since control which drives a pump is performed when fuel pressure becomes lower than the 2nd pressure smaller than the 1st pressure, since it always changes, highly precise fuel pressure control cannot do between the 1st pressure and the 2nd pressure, and fuel pressure lacks in the stability of control.

[0011] The 1st purpose of this invention is offering the fuel-pressure regulator valve used for the fuel supply system of the return loess method in which highly precise and stable fuel pressure control is possible, and this, controlling gassing without lengthening the die length of reference ********, and distance of a fuel-pressure regulator valve and a fuel injection valve.

[0012] The 2nd purpose of this invention is offering the fuel supply system which can aim at cheaply flow rate loss of a pump, and reduction of consumption power.

[0013]

[Means for Solving the Problem] The fuel tank where a fuel is stored according to this invention in order to attain the 1st purpose of the above, Fuel pump equipment equipped with a discharge-pressure maintenance means to restrict the fuel pump which pressurizes and carries out the regurgitation of the fuel in this fuel tank, and the discharge pressure of this fuel pump to the 1st predetermined value, At least one fuel injection valve which injects the fuel to which it connected with the downstream end of the fuel feeding pipe connected to said fuel pump equipment, and this fuel feeding pipe, respectively, and the upstream end was led from said fuel feeding pipe within [engine] inhalation of air, In the fuel supply system which has reference ******** which draws the reference pressure near the injection section of said fuel injection valve, and the fuel-pressure regulator valve which is connected to this reference ******** and adjusts the fuel pressure in said fuel feeding pipe While said fuel-pressure regulator valve is prepared on said fuel feeding pipe and holding the pressure of an upstream part from this fuel-pressure regulator valve below to the 1st predetermined value among these fuel feeding pipes The fuel supply system with which the pressure of a downstream part is characterized by making the fuel of said upstream part flow into said downstream part when it becomes smaller than the 2nd predetermined value smaller than the 1st predetermined value, and holding the pressure of this downstream part to said 2nd predetermined value is offered from this fuel-pressure regulator valve among these fuel feeding pipes.

[0014] Preferably, in said fuel supply system, said fuel-pressure regulator valve makes the fuel of an upstream part flow into a downstream part, if the differential pressure of the pressure of a downstream part and said ****** becomes smaller than predetermined differential pressure from this fuel-pressure regulator valve among these fuel feeding pipes, and the fuel supply system characterized by holding the pressure of said downstream part so that only said ****** to predetermined differential pressure may become large is offered.

[0015] Moreover, in said fuel supply system, the fuel supply system characterized by said fuel pump equipment having further the check valve which permits only the flow from said fuel pump to said direction of a fuel feeding pipe is offered preferably.

[0016] It sets to said fuel supply system still more preferably. Said fuel-pressure regulator valve It is prepared so that casing and the interior of casing may be classified into a ****** room and a pressure regulation room, and it responds to the size of the pressure of said reference ******, and the pressure of said pressure regulation interior of a room. Deformable diaphram, Reference pressure-welding **** to which it is fixed to

said ****** room side of said casing, and said reference ******** is connected, The pressure regulation fuel delivery where it is fixed to said pressure regulation room side of said casing, and a downstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The supply fuel end connection to which it is fixed to the pressure regulation room side of said casing, and an upstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The 1st hole which is formed in this supply fuel end connection, and opens this interior of a supply fuel end connection, and the exterior for free passage, It is arranged in said pressure regulation interior of a room, and deformation of said diaphram is embraced. A movable bulb movable in the deformation direction of this diaphram, If it is formed in this movable bulb and the differential pressure of the pressure of said pressure regulation interior of a room and the pressure of said reference ****** becomes small from said predetermined differential pressure, the fuel supply system characterized by having the 2nd hole which opens said the 1st hole and said pressure regulation room for free passage will be offered.

[0017] Moreover, in said fuel supply system, the fuel supply system characterized by equipping said discharge-pressure maintenance means with the relief valve connected by branching from the discharge-side duct of said fuel pump is offered preferably.

[0018] In order to attain the 1st and 2nd purposes of the above furthermore, preferably A pressure detection means to output the detecting signal which detects the pressure of an upstream part and corresponds from this fuel-pressure regulator valve among said fuel feeding pipes in said fuel supply system, The fuel supply system characterized by having further a pump-control means to control the drive of this fuel pump to become the 3rd predetermined value which has the pressure of said upstream part in the larger range smaller than said 1st predetermined value and than said 2nd predetermined value according to said detecting signal is offered.

[0019] Moreover, in order to attain the 1st purpose of the above, according to this invention, it connects with reference ******** which draws the reference pressure near the injection section of the fuel injection valve which injects a fuel within [engine] inhalation of air. In the fuel-pressure regulator valve which adjusts the fuel pressure in the fuel feeding pipe which leads a fuel to said fuel injection valve It is prepared so that casing and the interior of casing may be classified into a ****** room and a pressure regulation room, and it responds to the size of the pressure of said reference ******, and the pressure of said pressure regulation interior of a room. Deformable diaphram, Reference pressure-welding **** to which it is fixed to said ****** room side of said casing, and said reference ******** is connected, The pressure regulation fuel delivery where it is fixed to said pressure regulation room side of said casing, and a downstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The supply fuel end connection to which it is fixed to the pressure regulation room side of said casing, and an upstream part is connected from this fuel-pressure regulator valve among said fuel feeding pipes, The 1st hole which is formed in this supply fuel end connection, and opens this interior of a supply fuel end connection, and the exterior for free passage, It is arranged in said pressure regulation interior of a room, and deformation of said diaphram is embraced. A movable bulb movable in the deformation direction of this diaphram, If it is formed in this movable bulb and the differential pressure of the pressure of said pressure regulation interior of a room and the pressure of said reference ****** becomes small from the 1st predetermined differential pressure, the fuel pressure regulating valve characterized by having the 2nd hole which opens said the 1st hole and said pressure regulation room for free passage will be offered.

[0020] Preferably, in said fuel pressure regulating valve, the fuel pressure regulating valve characterized by preparing a part of inner circumference [at least] in contact with the periphery of said supply fuel end connection, and sliding on said movable bulb at the shaft orientations of this supply fuel end connection according to deformation of said diaphram is offered.

[0021] Moreover, preferably, in said fuel pressure regulating valve, it is arranged at said

reference ****** and the fuel pressure regulating valve characterized by having the spring with which an end energizes this diaphram toward said pressure regulation fuel delivery side in contact with said diaphram by the energization force of magnitude equal to said 1st predetermined differential pressure is offered.

[0022] In said fuel pressure regulating valve, the fuel pressure regulating valve characterized by said movable bulb having the opening part which will open said the 1st hole and said pressure regulation room for free passage if the differential pressure of the pressure of said pressure regulation interior of a room and the pressure of said reference ****** becomes small from the 2nd bigger predetermined differential pressure than said 1st predetermined differential pressure is offered still more preferably.

[0023]

[Function] In this invention constituted as mentioned above, while being breathed out with the fuel pump with which fuel pump equipment was equipped, the fuel with which the pressure was held with the discharge-pressure maintenance means at the 1st predetermined value is led to a fuel injection valve through a fuel feeding pipe, and this fuel is injected by the fuel injection valve within [engine] inhalation of air. And the fuel pressure in a fuel feeding pipe is adjusted by the fuel-pressure regulator valve to which the reference pressure near the fuel injection valve is led through reference ********. If this fuel-pressure regulator valve is prepared on a fuel feeding pipe and the pressure of a downstream part becomes smaller than the 2nd predetermined value at this time Since fuel return tubing like the conventional overflow control form fuel-pressure regulator valve becomes completely unnecessary by being the inflow control form fuel-pressure regulator valve which the fuel of an upstream part is made to flow into a downstream part, and holds a downstream pressure to the 2nd predetermined value Though it is a return loess method, a fuel-pressure regulator valve can be arranged near the fuel injection valve, and reference ******** can be shortened. Moreover, even when a fuel-pressure regulator valve is an inflow control form fuel-pressure regulator valve which makes the fuel of an upstream part flow into a downstream part when the pressure of a downstream part becomes small and the fuel of the downstream becomes an elevated temperature by the preheating after engine operation termination, a fuel-pressure regulator valve opens and is not open for free passage, and maintains the downstream to high pressure. That is, since a fuel-pressure regulator valve opens easily like before and the inside of a fuel feeding pipe does not serve as low voltage, generating of the air bubbles by the temperature rise is controlled. Furthermore, since the pressure of the downstream part of a fuel-pressure regulator valve is uniquely determined as the 2nd predetermined value, a pressure is not changed like before which performs a drive and a halt of a pump with a fuel control system, and highly precise and stable fuel pressure control can be performed.

[0024] Moreover, a fuel-pressure regulator valve can realize the function in which the differential pressure of the pressure of a downstream part and ****** makes regularity phase counter pressure of supply fuel pressure and the fuel injection valve injection section from a fuel-pressure regulator valve by making the fuel of an upstream part flow into a downstream part, and holding the pressure of a downstream part from ****** so that only predetermined differential pressure may become large if it becomes smaller than predetermined differential pressure, among fuel feeding pipes. Furthermore, the fuel of the downstream serves as an elevated temperature by the preheating after engine operation termination by preparing further the check valve which permits only the flow from a fuel pump to the direction of a fuel feeding pipe to fuel pump equipment, and while a fuel-pressure regulator valve does not open but the downstream is maintained to high pressure, since the back flow to the direction of a fuel pump is prevented and serves as high pressure, in the upstream, the inside of tubing does not serve as low voltage like before by the check valve. That is, generating of the air bubbles also according [the upstream] to a temperature rise is controlled. A fuel-pressure regulator valve is prepared so that casing and the interior of casing may be classified into a ****** room

and a pressure regulation room, and it responds to the size of the pressure of reference ******, and the pressure of the pressure regulation interior of a room. Moreover, deformable diaphram, Reference pressure-welding **** to which it is fixed to the ****** room side of casing, and reference ******** is connected, The pressure regulation fuel delivery where it is fixed to the pressure regulation room side of casing, and a downstream part is connected from a fuel-pressure regulator valve among fuel feeding pipes, The supply fuel end connection to which it is fixed to the pressure regulation room side of casing, and an upstream part is connected from a fuel-pressure regulator valve among fuel feeding pipes, The 1st hole which is formed in this supply fuel end connection, and opens the interior of a supply fuel end connection, and the exterior for free passage, When it is arranged in the pressure regulation interior of a room, and is formed in the deformation direction of diaphram at a movable movable bulb and this movable bulb according to deformation of diaphram and the differential pressure of the pressure of the pressure regulation interior of a room and the pressure of reference ****** becomes small from predetermined differential pressure, it has the 2nd hole which opens the 1st hole and pressure regulation room for free passage. If the pressure in the downstream part of a fuel feeding pipe becomes small and the differential pressure of the pressure of the pressure regulation interior of a room and the pressure of reference ****** becomes small by this, diaphram will deform into a pressure regulation room side, and a movable bulb will move to a pressure regulation room side according to this. And if the differential pressure of the pressure of further the pressure regulation interior of a room and the pressure of reference ****** becomes small and this value becomes small from the 1st predetermined differential pressure Since a movable bulb furthermore moves to a pressure regulation room side and the 1st hole and pressure regulation room of a supply fuel end connection are open for free passage through the 2nd hole of a movable bulb Through the 1st hole and 2nd hole, the fuel of the upstream part of a fuel feeding pipe can be made to be able to flow into a downstream part, and from ******, the pressure of a downstream part can be held so that only predetermined differential pressure may become small. Furthermore, a discharge-pressure maintenance means can realize a means to hold a pump discharge pressure to the 1st predetermined value, by having the relief valve connected by branching from the discharge-side duct of a fuel pump. Moreover, it has a pressure detection means to output the detecting signal which detects the pressure of an upstream part from a fuel-pressure regulator valve, and corresponds, and a pump-control means to control the drive of a fuel pump to become the 3rd predetermined value which has the pressure of an upstream part in the larger range smaller than the 1st predetermined value and than the 2nd predetermined value according to a detecting signal, among fuel feeding pipes. Since the downstream part of a fuel feeding pipe is maintained at the 3rd predetermined value with it by the 2nd predetermined value at this time, according to the size of a need fuel flow to a fuel injection valve, the drive of a fuel pump will be automatically controlled by the pump-control means. [than the 2nd predetermined value] [an upstream part smaller than the 1st predetermined value and] [bigger] Namely, although a lot of fuel flow is needed for a fuel injection valve at the time of high-speed operation, the fuel of a downstream part is quickly supplied to a fuel injection valve and the pressure of a downstream part tends to fall quickly Although a fuel is supplied to a downstream part from an upstream part by ******, and the pressure of a downstream part is maintained by the 2nd predetermined value and the pressure of an upstream part tends to fall quickly by this, that of a fuel-pressure regulator valve A fuel pump is controlled according to the rapid fall, it drives by high rotation, the pressure drop of an upstream part is prevented, and it maintains to the 3rd predetermined value. On the contrary, since a fuel flow required for a fuel injection valve is little at the time of low r.p.m. operation, it is sufficient for it, and the fuel of a downstream part is seldom supplied to a fuel injection valve but the pressure of a downstream part seldom falls, a fuel is seldom supplied to a downstream part from an upstream part, but the pressure of an upstream

part tends to fall slowly. Therefore, a fuel pump will be controlled according to this slow fall, and it will drive by low rotation. Thus, highly precise feedback control according to a need fuel flow and a pressure can be performed easily. That is, the differential pressure for flowing into a larger part downstream part than the 2nd predetermined value is securable by making the 3rd predetermined value at this time larger than the 2nd predetermined value. moreover, if the 3rd predetermined value is made larger than the 1st predetermined value, from it being held at the predetermined value of a basis 1st that the pressure of a fuel feeding pipe is also with a pump discharge-pressure maintenance means No matter what drive a pump may carry out, it cannot control, without resulting in the 3rd predetermined value, and whenever it makes it equal to the 1st predetermined value, the 3rd predetermined value will be reached, and there is no semantics to control. However, in this invention, by setting up the 3rd predetermined value smaller than the 1st predetermined value, the above-mentioned control can be performed effectively and reduction of a part with the 3rd predetermined value smaller than the 1st predetermined value, a pump flow rate loss, and pump consumption power can be aimed at.

[0025] Furthermore, in the fuel pressure regulating valve of this invention, by preparing a part of inner circumference [at least] in contact with the periphery of a supply fuel end connection, and sliding on the shaft orientations of a supply fuel end connection according to deformation of diaphram, a movable bulb is arranged in the pressure regulation interior of a room, and can realize a movable configuration in the deformation direction of diaphram. Moreover, it is arranged at reference ****** and a means to give the 1st predetermined differential pressure can be realized by having the spring with which an end energizes diaphram toward a pressure regulation fuel delivery side in contact with diaphram by the energization force of magnitude equal to the 1st predetermined differential pressure. The differential pressure of the pressure of the pressure regulation interior of a room and the pressure of reference ****** a movable bulb furthermore, by having the opening part which will open the 1st hole and pressure regulation room for free passage if it becomes smaller than the 2nd bigger predetermined differential pressure than the 1st predetermined differential pressure If a fuel temperature rises by the preheating after engine operation termination and the pressure of the downstream becomes the 2nd predetermined differential pressure, since a pressure regulation room and an upper part will be open for free passage through the 1st hole and opening part and the fuel of the downstream will flow into the upstream, the overpressure rise of the pressure regulation interior of a room can be prevented.

[0026]

[Example] Hereafter, drawing 1 - drawing 6 explain the example of this invention. Drawing 1 - drawing 4 explain the 1st example of this invention. This example is an example about a fuel supply system. The conceptual diagram showing the whole fuel supply system configuration by this example is shown in drawing 1 . In drawing 1 the fuel supply system 100 of this example Usually, the tank 1 by which it is prepared in the posterior part of an automobile for safety reservation, and a fuel is stored, Pump 2A which drives by the motor which is not illustrated, carries out suction pressurization and carries out the regurgitation of the fuel in a tank 1, Check-valve 2B which prevents the back flow of the fuel which connected with pump 2A and a serial and was breathed out, And the pumping plant 2 equipped with relief-valve 2C connected by branching from a discharge-pressure maintenance means, for example, the discharge-side duct of pump 2a, to hold the discharge pressure of pump 2A to the 1st predetermined value (after-mentioned), At least one injected within [of the engine which does not illustrate the fuel to which it connected with the downstream end of the fuel feeding pipe 3 connected to pumping plant 2, and this fuel feeding pipe 3, respectively, and the upstream end was led from the fuel feeding pipe 3] inhalation of air Reference ******** 6 which draws the reference pressure near the injection section of four fuel injection valves 9 and fuel injection valves 9, for example, the pressure of the intake manifold

collector section which is not illustrated, in the illustration example, While being prepared on a fuel feeding pipe 3, it connects with reference ******** 6, and it has the fuel-pressure regulator valve 4 which adjusts the fuel pressure in a fuel feeding pipe 3.
[0027] It connects with pump 2A and juxtaposition, relief-valve 2C opens an internal path, when too much rise of a supply pressure arises, it misses a fuel on a tank 1, and maintains a pressure at the 1st predetermined value. The fuel injection valve 9 is attached in the intake manifold section of an engine inlet pipe, the valve-opening control signal from the electronic control unit which is not illustrated is added, and the fuel oil consumption injected by the engine from a fuel injection valve 9 with this control signal is determined.
[0028] As the fuel-pressure regulator valve 4 adjusts the fuel pressure in the fuel feeding pipe 3 which is connected to reference ******** 6 and leads a fuel to a fuel injection valve 9 and is shown in drawing 5 mentioned later The diaphram 36 which classifies the casing 42 interior into the ****** room 51 and the pressure regulation room 52, Reference pressure-welding **** 44 to which reference ******** 6 is connected, and the pressure regulation fuel delivery 46 where downstream supply pipe 3b is connected from the fuel-pressure regulator valve 4 among fuel feeding pipes 3, The supply fuel end connection 22 to which upstream supply pipe 3a is connected from the fuel-pressure regulator valve 4 among fuel feeding pipes 3, The side hole 23 which opens the longitudinal hole 25 and the periphery slot 24 of the supply fuel end-connection 22 interior for free passage, Deformation of diaphram 36 is embraced. The movable bulb 26 movable in the deformation direction (the illustration vertical direction) of diaphram 36, It has the side hole 30 formed in this movable bulb 26, and the main spring 41 to which an end energizes diaphram 36 toward a pressure regulation fuel delivery side in contact with diaphram 36. If the differential pressure of the pressure of downstream supply pipe 3b of a fuel feeding pipe 3 and ****** drawn through reference ******** 6 becomes smaller than predetermined differential pressure by such configuration Make the fuel of upstream supply pipe 3a flow into downstream supply pipe 3b, and from ******, while holding only predetermined differential pressure so that it may become large, the pressure of downstream supply pipe 3b It has the function to hold the pressure of upstream supply pipe 3a of a fuel feeding pipe 3 to the 1st predetermined value beforehand set up by relief-valve 2C. In addition, the 1st predetermined value at this time is beforehand set up so that it may become always larger than the pressure of downstream supply pipe 3b.
[0029] Next, an operation of the fuel supply system 100 by this example constituted as mentioned above is explained. The fuel supply system 150 by the 1st example of a comparison of this example is shown in drawing 2 . This example of a comparison is an example of a comparison of the conventional fuel supply system which is not a return loess method. The same sign is given to a member equivalent to the fuel supply system 100 of this example. In drawing 2 , the main points that the fuel supply system 150 of this example of a comparison differs from the fuel supply system 100 of this example The fuel-pressure regulator valve 5 according to for example, an operation of ****** which the pressure regulation spring and reference ******** 6 which are the fuel-pressure regulator valve of an overflow control form as shown in JP,5-321792,A etc., and were prepared in the interior, and which are not illustrated drew It has the function to open an internal valve by pressure to which the differential pressure of the fuel pressure led to a fuel injection valve 9 and the pressure in the injection section of a fuel injection valve 9 becomes fixed, The overflow fuels for a surplus from this fuel-pressure regulator valve 5 are being returned to a tank 1 through the fuel return tubing 8, and prepared in the branch line 7 to which this fuel-pressure regulator valve's 5 is not on a fuel feeding pipe 3, and branched from the fuel feeding pipe 3. Other configurations are the same as that of the fuel supply system 100 of the 1st example almost.
[0030] In the above configuration, while the fuel-pressure regulator valve 5 had been arranged at the car-body anterior part in which an engine is carried, since it was usually

in the point empty vehicle object posterior part of safety reservation, the tank 1 was difficult for the fuel return tubing 8 to which both are connected to make it huge, and to attain space-saving-izing and ** cost-ization.

[0031] On the other hand, in the fuel supply system 100 of this example, the fuel-pressure regulator valve 4 is formed on a fuel feeding pipe 3, and if the pressure of downstream supply pipe 3b becomes small, fuel return tubing like the fuel-pressure regulator valve 5 of the above-mentioned conventional overflow control form will become completely unnecessary by being the inflow control form fuel-pressure regulator valve which makes the fuel of upstream supply pipe 3a flow into downstream supply pipe 3b. Therefore, space-saving-izing and ** cost-ization can be attained. The fuel supply system 170 by the 2nd example of a comparison of this example is shown in drawing 3 . This example of a comparison is the conventional fuel supply system which has adopted the return loess method. The same sign is given to a member equivalent to the fuel supply system 100 of this example, and the fuel supply system 150 of the 1st example of a comparison. In drawing 3 , the branch line 7 of the main points that the fuel supply system 170 of this example of a comparison differs from the fuel supply system 150 of the example of a comparison of the above 1st in which the fuel-pressure regulator valve 5 of an overflow control form is formed is the thing of pumping plant 2 which it has branched from the fuel feeding pipe 3 in near comparatively, and the die length of the fuel return tubing 8 is very short by this. Other configurations are the same as that of the fuel supply system 150 of the 1st example of a comparison almost.

[0032] In the above configuration, although the die length of the fuel return tubing 8 becomes very short (lost substantially) and the so-called return loess method can be realized by pumping plant 2 and the fuel-pressure regulator valve 5 approaching comparatively, and arranging them, since the die length of reference ******** 6 becomes long by one side, the effectiveness of shortening and simplification of the fuel return tubing 8 is reduced. Moreover, since the transfer lag of engine operational status arises, that the die length of reference ******** 6 becomes long worsens operability and an exhaust gas condition at the time of operational status change. Furthermore, since the distance of the fuel-pressure regulator valve 5 and a fuel injection valve 9 becomes long by attaching the fuel-pressure regulator valve 5 in about one tank, the fuel pressure fluctuation by about nine fuel injection valve becomes large, and highly precise fuel supply control becomes impossible. Moreover, engine heat is received, it is cooled by the fuel to pass, the engine cooling water which flows the interior of a manifold, the cooling wind, etc. at the time of operation, and the fuel injection valve 9 is maintained at about 50 degrees C and comparatively low temperature. However, although it is based also on operational status since all the above-mentioned cooling effects of after an engine shutdown are lost and the heat of a hotter exhaust air part is transmitted, it is after after [an engine shutdown] 10 minutes -, and 15-minute progress, and about nine-fuel injection valve temperature may exceed 100 degrees C. In such a condition, the fuel in a fuel feeding pipe 3 tends to carry out temperature up expansion, and a pressure also tends to rise. Since the fuel-pressure regulator valve 5 will open easily and overflow will be started here if the pressure in a fuel feeding pipe 3 exceeds the value of atmospheric pressure+1 constant differential pressure, since the reference pressure at the time of an engine shutdown is atmospheric pressure although the fuel-pressure regulator valve 5 opens so that differential pressure of the pressure in a fuel feeding pipe 3 and the reference pressure drawn from the reference ****** piping 6 may be made into a certain fixed differential pressure, and overflow control is performed, the rise of fuel pressure does not take place. Therefore, the air bubbles of a fuel are generated in a fuel feeding pipe 3, and the problem which worsens engine restart nature arises.

[0033] Moreover, since it is an overflow control form, while pumping plant 2 is always mostly maintained by the whole-quantity discharge condition, the fuel-pressure regulator valve 5 Since it is the configuration through which the part which deducted the fuel flow injected from the fuel injection valve 9 among the fuel flow sent out from

pumping plant 2 circulates to a tank 1 as an overflow flow rate For example, since an overflow flow rate arises in large quantities at the time of low r.p.m. operation and the circulating load of the fuel in a tank 1 is made [many], the fuel temperature rise in a tank 1 is caused, and the problem of enlarging the burden to the canister equipment for a fuel vapor cure which makes [many] the yield of a fuel vapor and does not illustrate it is generated. Here, in order to lessen this charge circulating load of tank 1 internal combustion according to this, it is possible to control the amount of sending out from pumping plant 2, but since the fuel pressure in a fuel feeding pipe 3 becomes almost equal to the overflow pressure of the fuel-pressure regulator valve 5, there is no room to control this alternatively. Or although there is also the approach of presuming from the control signal given to a fuel injection valve 9, for example, and controlling the supply voltage to the motor for pumps which is not illustrated, it does not become control of an in this case sufficiently high precision.

[0034] On the other hand, it sets to the fuel supply system 100 of this example. By being the inflow control form fuel-pressure regulator valve which makes the fuel of upstream supply pipe 3a flow into downstream supply pipe 3b when the fuel-pressure regulator valve 4 is formed on a fuel feeding pipe 3 and the differential pressure of the pressure of downstream supply pipe 3b and ****** becomes small from predetermined differential pressure Since fuel return tubing like the fuel-pressure regulator valve 5 of the above-mentioned conventional overflow control form becomes completely unnecessary, though it is a return loess method, the fuel-pressure regulator valve 4 can be arranged near the fuel injection valve 9, and reference ******** 6 can be shortened. That is, since about nine-fuel injection valve pressure fluctuation can be made small since the distance of the fuel-pressure regulator valve 4 and a fuel injection valve 9 becomes short, and reference ******** 6 becomes short, the responsibility to change of an engine operation condition can be raised. Moreover, even when the fuel-pressure regulator valve 4 is an inflow control form fuel-pressure regulator valve which makes the fuel of upstream supply pipe 3a flow into downstream supply pipe 3b when the pressure of downstream supply pipe 3b becomes small and the fuel of downstream supply pipe 3b becomes an elevated temperature by the preheating after engine operation termination, the fuel-pressure regulator valve 4 opens and is not open for free passage, and maintains downstream supply pipe 3b to high pressure. And at this time, by preparing further check-valve 2B which permits only the flow from pump 2A to fuel-feeding-pipe 3 direction in pumping plant 2, the back flow to the direction of pump 2A is prevented by check-valve 2B, and upstream supply pipe 3a is also maintained by high pressure. Therefore, since a fuel-pressure regulator valve opens easily like before and the inside of a fuel feeding pipe does not serve as low voltage, generating of the air bubbles by the temperature rise is controlled. Therefore, the fuel supply system excellent in engine restart nature can be offered. Moreover, since the pressure of downstream supply pipe 3b of a fuel feeding pipe 3 is uniquely determined that only predetermined differential pressure will become large from ******, a pressure is not changed like before which repeats a drive and a halt of a pump with a fuel control system, and controls fuel pressure in the fixed range, and it can perform highly precise and stable fuel pressure control. Moreover, since the fuel circulating load to tank 2C becomes only what was relieved by relief-valve 2C and a circulating load reduces it by being an inflow control form fuel-pressure regulator valve, the rise of the fuel temperature in a tank 1 can be prevented.

[0035] Drawing 4 explains the 2nd example of this invention. This example is also an example about a fuel supply system as well as the 1st example. The conceptual diagram showing the whole fuel supply system 200 configuration by this example is shown in drawing 4 . The same sign is given to a member equivalent to the 1st example. The main points that the fuel supply system 200 of this example differs from the fuel supply system 100 of the 1st example in drawing 4 are having, a pressure detection means 10, for example, a pressure sensor, changing and outputting the pressure of upstream supply pipe 3a of a fuel feeding pipe 3 to the detecting signal which detects and corresponds, and

a pump-control means 11, for example, an electronic control, controlling the pump drive motor which the detecting signal from this pressure sensor 10 responds for inputting, and is not illustrated through an output line 13. In the control software which is not illustrated in an electronic control 11 here The 3rd predetermined value in the larger range smaller than the 1st predetermined value mentioned above in the 1st example and than the 2nd predetermined value is set up beforehand. The signal from a pressure sensor 10 It is inputted into the control software through the analog-to-digital-conversion equipment which is not illustrated in an electronic control 11. It is compared with the 3rd predetermined value in this control software, and the driving signal which drives a pump 2 so that the pressure of upstream supply pipe 3a may serve as this 3rd predetermined value is outputted through an output line 13. In addition, this electronic control 11 can also be used also [electronic control / which gives the valve-opening time amount signal which is not illustrated to a fuel injection valve 9, and determines the fuel amount of supply to an engine uniquely]. The 3rd above-mentioned predetermined value can be selected to a fluctuation possible value etc. in the range which made the one set point which considers as the one set point set as arbitration, or is defined according to an engine's operational status, or was described above. This 3rd predetermined value is not necessarily the need always, and only when a pump operates by the above capacity to some extent so to speak, it is required. That is, if it is more than the pressure that downstream supply pipe 3b needs, the function of a fuel supply system will be materialized theoretically. In addition, in setting nothing up as this 3rd predetermined value, the pressure of downstream supply pipe 3b turns into relief pressure force of pumping plant 2 automatically.

[0036] In the fuel supply system 200 of the above-mentioned configuration, it has the pressure sensor 10 which outputs the detecting signal which detects the pressure of upstream supply pipe 3a of a fuel feeding pipe 3, and corresponds, and the electronic control 11 which controls the drive of pump 2A to become the 3rd predetermined value which has the pressure of upstream supply pipe 3a in the larger range smaller than the 1st predetermined value and than the 2nd predetermined value according to a detecting signal. Since the pressure of upstream supply pipe 3a is maintained at the 3rd predetermined value by the 2nd predetermined value which mentioned above the pressure of downstream supply pipe 3b at this time, according to the size of a need fuel flow to a fuel injection valve 9, the drive of pump 2A will be automatically controlled by the electronic control 11 by it. Namely, although a lot of fuel flow is needed for a fuel injection valve 9 at the time of high-speed operation, the fuel of downstream supply pipe 3b is quickly supplied to a fuel injection valve 9 and the pressure of downstream supply pipe 3b tends to fall quickly Although a fuel is supplied to downstream supply pipe 3b from upstream supply pipe 3a by ******, and the pressure of downstream supply pipe 3b is maintained by the 2nd predetermined value and the pressure of upstream supply pipe 3a tends to fall quickly by this, that of the fuel-pressure regulator valve 5 Pump 2A is controlled according to the rapid fall, it drives by high rotation, the pressure drop of upstream supply pipe 3a is prevented, and it maintains to the 3rd predetermined value. On the contrary, since a fuel flow required for a fuel injection valve 9 is little at the time of low r.p.m. operation, it is sufficient for it, and the fuel of downstream supply pipe 3b is seldom supplied to a fuel injection valve 9 but the pressure of downstream supply pipe 3b seldom falls, a fuel is seldom supplied to downstream supply pipe 3b from upstream supply pipe 3a, but the pressure of upstream supply pipe 3a tends to fall slowly. Therefore, pump 2A will be controlled according to this slow fall, and it will drive by low rotation. Thus, highly precise feedback control according to a need fuel flow and a pressure can be performed easily. That is, the differential pressure for flowing into larger part downstream supply pipe 3b than the 2nd predetermined value is securable by making the 3rd predetermined value at this time larger than the 2nd predetermined value. Moreover, if the 3rd predetermined value is made larger than the 1st predetermined value, since it is held at the predetermined value of a basis 1st that the

pressure of a fuel feeding pipe 3 is also for relief-valve 2C, no matter what drive pump 2A may carry out, it does not result in the 3rd predetermined value and cannot control. Moreover, whenever it makes it equal to the 1st predetermined value, the 3rd predetermined value will be reached, and there is no semantics to control. However, in this example, by setting up the 3rd predetermined value smaller than the 1st predetermined value, the above-mentioned control can be performed effectively and reduction of a part with the 3rd predetermined value smaller than the 1st predetermined value, a pump flow rate loss, and pump consumption power can be aimed at.

[0037] In addition, in the above-mentioned configuration, although both a pressure sensor 10 and an electronic control 11, and relief-valve 2C (refer to drawing 1) with which pumping plant 2 was equipped were prepared, relief-valve 2C can also be omitted and a pressure sensor 10 and an electronic control 11 will constitute a discharge-pressure maintenance means in this case. Moreover, the configuration which controls a driving signal so that a pressure value may not be changed into a continuous electrical signal, switching operation may be carried out with a specific pressure value and this switch signal is intermittent with a predetermined time interval is sufficient as a pressure sensor 10. The same effectiveness is acquired also in this case. furthermore, the driving signal to which the driving signal from an output line 13 is a known approach, for example, the current value was changed continuously and the driving signal which is simply intermittent in a pump -- or it is also possible to select to the driving signal with which the real drive current value was controlled by duty change. The same effectiveness is acquired also in this case.

[0038] Drawing 5 and drawing 6 explain the 3rd example of this invention. This example is an example of the fuel-pressure regulator valve used in the fuel supply system 100,200 of the 1st and 2nd examples. The same sign is given to a member equivalent to the 1st and 2nd examples. Drawing of longitudinal section showing the configuration of the fuel-pressure regulator valve 4 of this example is shown in drawing 5 . The fuel-pressure regulator valve 4 is connected to reference ******** 6 which draws the reference pressure near the injection section of the fuel injection valve 9 which injects a fuel within [of the engine which is not illustrated] inhalation of air in drawing 5 . The casing 42 which adjusts the fuel pressure in the fuel feeding pipe 3 (refer to drawing 1 and drawing 4 above) which leads a fuel to a fuel injection valve 9, and consists of casing-upper-half 42U and casing-lower-half 42L, The diaphram 36 classified into the pressure regulation room 52 which is arranged in the casing 42 interior at the ****** room 51 and illustration lower part which are arranged in the illustration upper part, and adjusts the pressure of a supply fuel, Reference pressure-welding **** 44 to which it is airtightly fixed to casing-upper-half 42U, and reference ******** 6 is connected, The pressure regulation fuel delivery 46 where it is fixed to an oiltight by casing-lower-half 42L, and downstream supply pipe 3b (refer to drawing 1 and drawing 4) of a fuel feeding pipe 3 is connected to it, The supply fuel end connection 22 to which it is fixed to casing-lower-half 42L, and upstream supply pipe 3a of a fuel feeding pipe 3 is connected, At least one side hole 23 which opens for free passage the periphery slot 24 which was formed in this supply fuel end connection 22, and was formed in the longitudinal hole 25 and periphery of the supply fuel end-connection 22 interior, It is arranged in the pressure regulation room 52, and deformation (after-mentioned) of diaphram 36 is embraced. The movable bulb 26 movable in the deformation direction (the illustration vertical direction) of diaphram 36, The bulb holder 34 which transmits deformation migration of diaphram 36 to the movable bulb 26 while holding the movable bulb 26, It has the side hole 30 formed in the movable bulb 26, and the main spring 41 to which it is arranged in the ****** room 51 and an end energizes diaphram 36 toward a pressure regulation fuel delivery side (illustration down) in contact with diaphram 36.

[0039] diaphram 36 -- ****** of the bulb holder 34 -- in a center section, it is mostly put between spring retainers 37, is held by closing the step 38 of the bulb holder 34, and is deformable as a pressure receiving member according to the size of the pressure in the

****** room 51, and the pressure in the pressure regulation room 52. Moreover, the diaphram guide 40 to which it shows deformation migration in the upper part of diaphram 36 is formed in the upper part of diaphram 36, and this diaphram guide 40, diaphram 36, and the upper limit section of casing-lower-half 42L are being fixed by closing the lower limit section of casing-upper-half 42U. The upper part of the bulb holder 34 is extended as the stopper section 39, and can restrict migration in too much upper part of the bulb holder 34 and the movable bulb 26 in contact with casing-upper-half 42U as occasion demands. The main spring 41 is pinched between casing-upper-half 42U and a spring retainer 37, the energization force is equal to the 1st predetermined differential pressure, and the energization force is finely tuned by making the shoulder 43 of casing-upper-half 42U deform suitably.

[0040] The movable bulb 26 can give the energization force from the illustration upper part with the subsp. ring 47 which was held by the caulking section 35 of the bulb holder 34 at the bulb edge 33 of neck 31 upper limit of a minor diameter and by which endocyst is carried out to the bulb holder 34 while pressing down, inserting in a plate 32 and being contacted from an illustration lower part with the presser-foot plate of a bulb edge 33 smell lever, and is held by these having two incomes at shaft orientations (the illustration vertical direction). This presser-foot plate 32 has the bore section with a notch, as shown in drawing 6 , and the magnitude of this bore is larger than the neck 31 of the movable bulb 26. Movement of the illustration longitudinal direction of the bulb edge 33 and the depth direction becomes free by this, and alignment nature is given between the fuel-supply end connection 22 and the movable bulb 26. Moreover, the movable bulb 26 equips the upper limit section of a bore part with the bore limb 27, and the lower limit section of this bore limb 27 forms the bulb edge section 29. And while the pressure regulation slot 48 and at least one side hole 49 are formed in a downward bore part at the pan of this bulb edge section 29, it has fitted in with the periphery of the supply fuel end connection 22, and the movable bulb 26 can slide on the shaft orientations (the illustration vertical direction) of the supply fuel end connection 22 according to deformation of diaphram 36.

[0041] The actuation and the operation in the above-mentioned configuration are explained.

[0042] The fuel-pressure adjustment actuation in the fuel-pressure regulator valve 4 of this example is made by the balance of the force which mainly acts on diaphram 36 from the upper and lower sides. That is, while the reference pressure, i.e., the pressure of the injection section of a fuel injection valve 9 (refer to drawing 1 and drawing 4) and the energization force of a main spring 41, led to the ****** room 51 acts to an illustration lower part to diaphram 36, the pressure in the pressure regulation room 52 acts on the illustration upper part to diaphram 36.

[0043] If the pressure in downstream supply pipe 3b of a fuel feeding pipe 3 becomes small here and the differential pressure of the pressure in the equal pressure regulation room 52 and the pressure in the ****** room 6 becomes small substantially with this pressure, diaphram 36 will deform into the pressure regulation room 52 side (illustration lower part), and the movable bulb 26 will move to the pressure regulation room 52 side (illustration lower part) according to this. And if the differential pressure of the pressure in the pressure regulation room 52 and the pressure in the ****** room 6 becomes small and becomes small further from the 1st predetermined differential pressure equal to the energization force of a main spring 41 (i.e., if the resultant force with the pressure in the ****** room 51 and the energization force of a main spring 41 becomes larger than the pressure in the pressure regulation room 52), the side hole 23 and the pressure regulation room 52 of the supply fuel end connection 22 will be open for free passage through the side hole 30 of the movable bulb 26. Therefore, the fuel which was sent out from pumping plant 2 and supplied from upstream supply pipe 3a of a fuel feeding pipe 3 flows into downstream supply pipe 3b from the dugout 25 of the supply fuel end connection 22 through a side hole 23, the periphery slot 24, the bore limb 27 of the

movable bulb 26 and a side hole 30, the pressure regulation room 52, and the pressure regulation fuel delivery 46. In addition, in order to regulate migration in too much lower part of the movable bulb 26, it can also constitute so that the upper limit section 28 of the bore limb 27 of the movable bulb 26 may be made to contact the external upper limit section of the supply fuel end connection 22. If a fuel flows as mentioned above and the pressure of the pressure regulation room 52 rises, diaphram 36 and the bulb holder 34, and the movable bulb 26 move up. And if the differential pressure of the pressure in the pressure regulation room 52 and the pressure in the ****** room 51 becomes larger than the 1st predetermined differential pressure equal to the energization force of a main spring 41 Namely, if it becomes larger than resultant force with the pressure in the ****** room 51 which the upward force of acting on diaphram 36 from the pressure regulation room 52 mentioned above, and the energization force of a main spring 41 The bulb edge section 29 of the movable bulb 26 blockades the periphery slot 24 of the supply fuel end connection 22, and the fuel from a longitudinal hole 25 stops flowing into the pressure regulation room 52.

[0044] By actuation explained above, from ******, the pressure of downstream supply pipe 3b is always held so that only predetermined differential pressure may become large. That is, since the differential pressure of the fuel pressure led to a fuel injection valve 9 (refer to drawing 1 and drawing 4) and the pressure in the injection section of the fuel injection valve 9 which is ****** becomes fixed irrespective of engine operational status, the fuel amount-of-supply control of it with a high precision is attained. moreover , since the active area to which the pressure in the pressure regulation room 52 act on diaphram 36 at illustration facing up do not change even if the control path for fuel-pressure adjustment be form in the cylinder periphery section of the supply fuel end connection 22 , and the cylinder inner circumference section of the movable bulb 26 , this control path be open for free passage through a side hole 23 or a side hole 30 and it close at this time , the small pressure regulation function of pressure fluctuation that precision be high and can be obtain .

[0045] Moreover, if an engine stops and the fuel temperature of the parts of downstream supply pipe 3b of a fuel feeding pipe 3 or a fuel injection valve 9 rises, the volume of a fuel will expand, the pressure of this part will rise, and the pressure of the pressure regulation room 52 will also rise. By arranging downward lock out **** sufficiently caudad from the bulb edge section 29 in the movable valve 26, although diaphram 36, the bulb holder 34, and the movable valve 26 will also move up according to this, even if the movable valve 26 moves upwards, it supposes that the bore section has blockaded the periphery slot 24, and things can be carried out. Since this cannot be wide opened even if the fuel pressure of the lower stream of a river which includes the pressure regulation room 52 by this rises, but fuel pressure is held in the sufficiently high-pressure state, it is possible for generating of fuel air bubbles to be controlled and to prevent aggravation of engine restart nature. Furthermore, in order to ensure the high-pressure condition of this fuel, a dimension can be determined that it makes the stopper section 39 of the bulb holder 34 contact casing-upper-half 42U at the time of upper part migration of such a movable valve 26, the bulb holder 34, and diaphram 36, and migration in the upper part of the movable valve 26 can also be regulated by this.

[0046] However, the effect of the pressure buildup by the cubical expansion resulting from the fuel temperature rise at this time is farther [than the pressure relaxation effect by that bulk modulus] large, when not carrying out a volume change at all, it serves as a big pressure buildup too much, and un-arranging [which will require too much pressure resistance] produces it on the use components containing a piping network. In here, too much rise of a pressure can be first eased by taking the large path of diaphram 36 suitably by the fuel-pressure regulator valve 4 of this example in permuting primary cubical expansion [in /-like / the downstream after the pressure regulation room 52] by deformation migration of diaphram 36. And although diaphram 36 and the movable bulb 26 will move up if a pressure still continues rising If the differential pressure of the

pressure in the pressure regulation room 52 and the pressure in the ****** room 51 becomes larger than the predetermined differential pressure set as a certain larger value than predetermined differential pressure The pressure regulation slot 48 and side hole 49 which were prepared in the movable bulb 26 carry out opening to the side hole 23 and the pressure regulation slot 24 which were established in the supply (for example, before the stopper section 39 contacts casing-upper half 43) fuel end connection 22, and open these side holes 23 and the pressure regulation slot 24, and the pressure regulation room 52 for free passage. Thereby, since the fuel of the downstream after the pressure regulation room 52 flows into upstream supply pipe 3a of a fuel feeding pipe 3 through a side hole 49, the pressure regulation slot 48, the periphery slot 24, and a longitudinal hole 25, the volume which connotes a fuel becomes large and it can prevent an overpressure rise. Therefore, the safety of the fuel-pressure regulator valve 4 and a fuel supply system 100,200 (refer to drawing 1 and drawing 4) can be improved.

[0047] In addition, in the above, although considered as the structure which misses a high-pressure fuel to the upstream through the side hole 49 and the pressure regulation slot 48 which were established in the lower part of the movable bulb 26, it is not restricted to this but a downward part may be omitted from the location of a side hole 49 and the pressure regulation slot 48 in the cross-section structure of the illustration movable bulb 26. If it is made this structure and the differential pressure of the pressure in the pressure regulation room 52 and the pressure in the ****** room 51 will become smaller than the 2nd predetermined differential pressure The lower limit (it will exist in illustration side hole 49 location mostly in this case) of the movable bulb 26 It will move more nearly up than the side hole 23 and the pressure regulation slot 24 of the supply fuel end connection 22, namely, the periphery of a side hole 23 and the pressure regulation slot 24 will deviate from the inner circumference of the movable bulb 26, and it will be opened wide at the direct pressure regulation room 52. The same effectiveness is acquired also by this.

[0048]

[Effect of the Invention] Since according to this invention a fuel-pressure regulator valve is an inflow control form fuel-pressure regulator valve which the fuel of an upstream part is made to flow into a downstream part, and holds a downstream pressure to the 2nd predetermined value when it is prepared on a fuel feeding pipe and the pressure of a downstream part becomes smaller than the 2nd predetermined value, fuel return tubing like the conventional overflow control form fuel-pressure regulator valve becomes completely unnecessary. Therefore, though it is a return loess method, a fuel-pressure regulator valve can be arranged near the fuel injection valve, and reference ******** can be shortened. That is, since pressure fluctuation near the fuel injection valve can be made small since the distance of a fuel pressure regulator valve and a fuel injection valve becomes short, and reference ******** becomes short, the responsibility to change of an engine operation condition can also be raised. Moreover, since a fuel-pressure regulator valve is not open for free passage and the downstream is maintained to high pressure even when the fuel of the downstream becomes an elevated temperature by remaining heat after engine operation termination, generating of the air bubbles by the temperature rise is controlled, and the fuel supply system excellent in engine restart nature can be offered. Furthermore, since the pressure of the downstream part of a fuel-pressure regulator valve is uniquely determined as the 2nd predetermined value, highly precise and stable fuel pressure control can be performed. Moreover, the fuel circulating load to a tank can be reduced and the rise of the charge temperature of fuel tank internal combustion can be reduced. Moreover, the fuel supply system which the back flow to the direction of a fuel pump was prevented, the upstream also became high pressure at the time of the fuel elevated temperature after engine operation termination, and generating of the air bubbles by the temperature rise was controlled by it, and was excellent in it at engine restart nature since the check valve which permits only the flow from a fuel pump to the direction of a fuel feeding pipe was further prepared in fuel pump

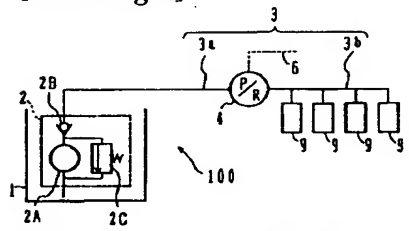
equipment can be offered. Furthermore, from ******, if the differential pressure of the pressure of the pressure regulation interior of a room and the pressure of reference ****** becomes small and this value becomes small from predetermined differential pressure, since the 1st hole and pressure regulation room of a supply fuel end connection will be open for free passage through the 2nd hole of a movable bulb, the pressure of a downstream part can be held so that only predetermined differential pressure may become large. Moreover, since the active area of the force of acting on diaphram from a pressure regulation room side does not change even if the 1st hole and pressure regulation room are open for free passage and it does not carry out, the small pressure regulation function of pressure fluctuation that precision is high and can be obtained. Furthermore, a pressure detection means to output the detecting signal which detects the pressure of an upstream part and corresponds from a fuel-pressure regulator valve among fuel feeding pipes, Since it has a pump-control means to control the drive of a fuel pump so that it may become the 3rd predetermined value which has the pressure of an upstream part in the larger range smaller than the 1st predetermined value and than the 2nd predetermined value according to a detecting signal Highly precise feedback control according to a need fuel flow and a pressure can be performed easily, and reduction of a pump flow rate loss and pump consumption power can be aimed at.
[0049] Moreover, since according to this invention it has the opening part which opens the 1st hole and pressure regulation room for free passage when a movable bulb becomes larger than the 2nd predetermined differential pressure with the bigger differential pressure of the pressure of the pressure regulation interior of a room, and the pressure of reference ****** than the 1st predetermined differential pressure If a fuel temperature rises by the preheating after engine operation termination and the pressure of the downstream becomes the 2nd predetermined differential pressure, a pressure regulation room and an upper part are open for free passage through the 1st hole and opening part, and the fuel of the downstream can flow into the upstream and can prevent the overpressure rise of the pressure regulation interior of a room. Therefore, the safety of a fuel-pressure regulator valve and a fuel supply system can be improved.

[Brief Description of the Drawings]
[Drawing 1] It is the conceptual diagram showing the whole fuel supply system configuration by the 1st example of this invention.
[Drawing 2] It is the conceptual diagram showing the whole fuel supply system configuration by the 1st example of a comparison of the 1st example.
[Drawing 3] It is the conceptual diagram showing the whole fuel supply system configuration by the 2nd example of a comparison of the 1st example.
[Drawing 4] It is the conceptual diagram showing the whole fuel supply system configuration by the 2nd example of this invention.
[Drawing 5] It is drawing of longitudinal section showing the configuration of the fuel-pressure regulator valve by the 3rd example of this invention.
[Drawing 6] It is the plan which was shown in drawing 5 and in which pressing down and showing the configuration of a plate.

[Description of Notations]
1 Fuel Tank
2 Pumping Plant
2A Fuel pump
2B Check valve
2C Relief valve (discharge-pressure maintenance means)
3 Fuel Feeding Pipe
3a Upstream supply pipe
3b Downstream supply pipe
4 Inflow Control Form Fuel-pressure Regulator Valve
5 Overflow Control Form Fuel-pressure Regulator Valve
6 Reference ********
7 Branch Line
8 Fuel Return Tubing
9 Fuel Injection Valve
10 Pressure Sensor (Pressure Detection

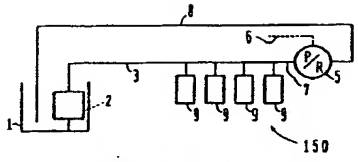
Means)
11 Electronic Control (Pump-Control Means)
13 Output Line
22 Supply Fuel End Connection
23 Side Hole (1st Hole)
24 Periphery Slot
25 Longitudinal Hole
26 Movable Bulb
30 Side Hole (2nd Hole)
34 Bulb Holder
36 Diaphram
37 Spring Retainer
39 Stopper Section
41 Main Spring (Spring)
42 Casing
42U Casing-upper half
42L Casing lower half
43 Shoulder
44 Reference Pressure-Welding ****
46 Pressure Regulation Fuel Delivery
48 Pressure Regulation Slot (Opening Part)
49 Side Hole (Opening Part)
51 ****** Room
52 Pressure Regulation Room
100 Fuel Supply System
200 Fuel Supply System

[Drawing 1]



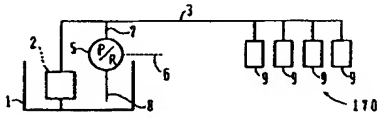
1:燃料タンク
2:ポンプ装置
2A:燃料ポンプ
2B:チェック弁
2C:リリーフ弁(吐出圧保持手段)
3:燃料供給管
3a:上流側供給管
3b:下流側供給管
4:流入制御形燃圧調整弁
6:参照圧導入管
7:分岐配管
9:燃料噴射弁
100燃料供給装置

[Drawing 2]

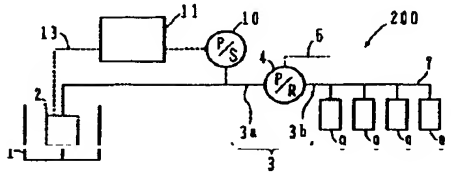


5:過流制御形燃圧調整弁 8:燃料戻し管

[Drawing 3]

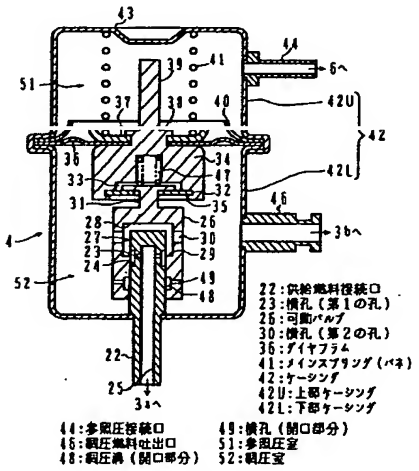


[Drawing 4]



10:プレッシャセンサ(圧力検出手段)
11:電子制御装置(ポンプ制御手段)
13:出力線
200:燃料供給装置

[Drawing 5]



44:参照圧接続口
46:調圧燃料吐出口
48:調圧溝(開口部分)
49:横孔(開口部分)
51:参照圧室
52:調圧室

[Drawing 6]

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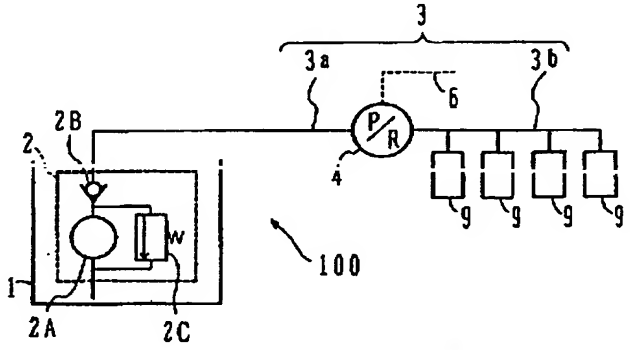
(54)【発明の名称】　燃料供給装置及び燃圧調整弁

(57)【要約】
【目的】参照圧導入管の長さ及び燃圧調整弁と燃料噴射弁との距離を長くすることなく、かつ気泡発生を抑制しつつ、高精度で安定的な燃料圧力制御が可能なリターンレス方式の燃料供給装置及びこれに用いる燃圧調整弁を提供する。
【構成】燃料供給装置１００は、タンク１と、ポンプ２Ａ、チェック弁２Ｂ、リリーフ弁２Ｃを備えたポンプ装置２と、燃料供給管３と、燃料供給管３から導かれた燃料を噴射する燃料噴射弁９と、燃料噴射弁９噴射部近傍の参照圧力を導く参照圧導入管６と、燃料供給管３の下流側供給管３ｂの圧力と参照圧導入管６を介し導かれた参照圧との差圧が所定差圧より小さくなると、上流側供給管３ａの燃料を下流側供給管３ｂに流入させ、下流側供給管３ｂの圧力が参照圧より所定差圧だけ大きくなるように保持する流入制御形の燃圧調整弁４とを有する。



1：燃料タンク
2：ポンプ装置
2A：燃料ポンプ
2B：チェック弁
2C：リリーフ弁（吐出圧保持手段）
3：燃料供給管
3a：上流側供給管
3b：下流側供給管
4：流入制御形燃圧調整弁
6：参照圧導入管
7：分岐配管
9：燃料噴射弁
100燃料供給装置

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【特許請求の範囲】

【請求項１】　燃料が貯留される燃料タンクと、この燃料タンク内の燃料を加圧し吐出する燃料ポンプ及びこの燃料ポンプの吐出圧を第１の所定値に保持する吐出圧保持手段を備えた燃料ポンプ装置と、上流側一端が前記燃料ポンプ装置に接続された燃料供給管と、この燃料供給管の下流側一端にそれぞれ接続され前記燃料供給管から導かれた燃料をエンジンの吸気管内に噴射する少なくとも１つの燃料噴射弁と、前記燃料噴射弁の噴射部近傍の参照圧力を導く参照圧導入管と、この参照圧導入管に接続され前記燃料供給管内の燃料圧力を調整する燃圧調整弁とを有する燃料供給装置において、

前記燃圧調整弁は、前記燃料供給管上に設けられており、該燃料供給管のうち該燃圧調整弁より上流側部分の圧力を第１の所定値に保持するとともに、該燃料供給管のうち該燃圧調整弁より下流側部分の圧力が第１の所定値より小さい第２の所定値よりも小さくなると、前記上流側部分の燃料を前記下流側部分に流入させ該下流側部分の圧力を前記第２の所定値に保持することを特徴とする燃料供給装置。

【請求項２】　請求項１記載の燃料供給装置において、前記燃圧調整弁は、該燃料供給管のうち該燃圧調整弁より下流側部分の圧力と前記参照圧との差圧が所定差圧より小さくなると、上流側部分の燃料を下流側部分に流入させて前記下流側部分の圧力を前記参照圧から所定差圧だけ大きくなるように保持することを特徴とする燃料供給装置。

【請求項３】　請求項１記載の燃料供給装置において、前記燃料ポンプ装置は、前記燃料ポンプから前記燃料供給管方向への流れのみを許容する逆止弁をさらに有することを特徴とする燃料供給装置。

【請求項４】　請求項１記載の燃料供給装置において、前記燃圧調整弁は、ケーシングと、ケーシング内部を参照圧室と調圧室とに区分するように設けられ前記参照圧室内の圧力と前記調圧室内の圧力との大小に応じて変形可能なダイヤフラムと、前記ケーシングの前記参照圧室側に固定され前記参照圧導入管が接続される参照圧接続口と、前記ケーシングの前記調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より下流側部分が接続される調圧燃料吐出口と、前記ケーシングの調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より上流側部分が接続される供給燃料接続口と、この供給燃料接続口に形成され該供給燃料接続口内部と外部とを連通する第１の孔と、前記調圧室内に配置され前記ダイヤフラムの変形に応じて該ダイヤフラムの変形方向に移動可能な可動バルブと、この可動バルブに形成され前記調圧室内の圧力と前記参照圧室内の圧力との差圧が前記所定差圧より小さくなると前記第１の孔と前記調圧室とを連通する第２の孔とを有することを特徴とする燃料供給装置。

【請求項５】　請求項１記載の燃料供給装置において、

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前記吐出圧保持手段は、前記燃料ポンプの吐出側管路から分岐して接続されたリリーフ弁を備えていることを特徴とする燃料供給装置。

【請求項６】　請求項１記載の燃料供給装置において、前記燃料供給管のうち該燃圧調整弁より上流側部分の圧力を検出し対応する検出信号を出力する圧力検出手段と、前記検出信号に応じ前記燃料ポンプの吐出圧が、前記第１の所定値より小さくかつ前記第２の所定値より大きい範囲にある第３の所定値になるように該燃料ポンプの駆動を制御するポンプ制御手段とをさらに有し、前記燃圧調整弁は、前記燃料供給管のうち該燃圧調整弁より上流側部分の圧力を前記第３の所定値に保持されたことを特徴とする燃料供給装置。

【請求項７】　エンジンの吸気管内に燃料を噴射する燃料噴射弁の噴射部近傍の参照圧力を導く参照圧導入管に接続され、前記燃料噴射弁に燃料を導く燃料供給管内の燃料圧力を調整する燃圧調整弁において、ケーシングと、ケーシング内部を参照圧室と調圧室とに区分するように設けられ前記参照圧室内の圧力と前記調圧室内の圧力との大小に応じて変形可能なダイヤフラムと、前記ケーシングの前記参照圧室側に固定され前記参照圧導入管が接続される参照圧接続口と、前記ケーシングの前記調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より下流側部分が接続される調圧燃料吐出口と、前記ケーシングの調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より上流側部分が接続される供給燃料接続口と、この供給燃料接続口に形成され該供給燃料接続口内部と外部とを連通する第１の孔と、前記調圧室内に配置され前記ダイヤフラムの変形に応じて該ダイヤフラムの変形方向に移動可能な可動バルブと、この可動バルブに形成され前記調圧室内の圧力と前記参照圧室内の圧力との差圧が第１の所定差圧より小さくなると前記第１の孔と前記調圧室とを連通する第２の孔とを有することを特徴とする燃料調圧弁。

【請求項８】　請求項７記載の燃料調圧弁において、前記可動バルブは、内周の少なくとも一部分が前記供給燃料接続口の外周に接して設けられ、前記ダイヤフラムの変形に応じ該供給燃料接続口の軸方向に摺動することを特徴とする燃料調圧弁。

【請求項９】　請求項７記載の燃料調圧弁において、前記参照圧室内に配置され、一端が前記ダイヤフラムに当接し該ダイヤフラムを前記第１の所定差圧に等しい大きさの付勢力で前記調圧燃料吐出口側に向かって付勢するバネを有することを特徴とする燃料調圧弁。

【請求項１０】　請求項７記載の燃料調圧弁において、前記可動バルブは、前記調圧室内の圧力と前記参照圧室内の圧力との差圧が、前記第１の所定差圧よりも大きな第２の所定差圧より大きくなると前記第１の孔と前記調圧室とを連通する開口部分を有することを特徴とする燃料調圧弁。

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【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、例えば自動車エンジンの燃焼室内に燃料を供給する燃料供給装置に係わり、特に、燃料の圧力を調整する燃圧調整弁を備えた燃料供給装置及びこの燃圧調整弁に関する。

【０００２】

【従来の技術】従来の自動車用燃料供給装置においては、一般に、その燃料圧力を溢流制御形燃圧調整弁を用いて調整している。このような燃料供給装置に関する公知技術としては、例えば、以下のものがある。

【０００３】①特開昭５３－４０１０５号公報

この公知技術においては、タンク中に設けられたポンプ装置から出た燃料が、燃料供給管を介して直列に接続された溢流制御形燃圧調整弁へ導かれる。燃圧調整弁には例えばインテークマニホールドコレクタ部の圧力が参照圧導入管を介し導かれており、この圧力に基づき、燃料噴射弁の噴射部圧力と燃料圧力との差圧が一定に保つように制御され、余剰分の溢流燃料は戻し管を介しタンクに戻される。

【０００４】②特開昭４７－１３５５８号公報

この公知技術は、溢流制御形燃圧調整弁は燃料供給管から分岐して並列に接続されるとともにタンク近傍に配置することが可能であり、これにより、溢流燃料をタンクに戻すための戻し管を実質的に省略しスペースやコストを低減するもので、リターンレス方式と呼ばれるものが構成できる。

【０００５】また、燃圧調整弁を設けず他の手段で燃料圧力を調整する公知技術として、以下のものがある。

【０００６】③特表平２－５００７６４号公報

この公知技術は、燃料供給管から分岐して並列に接続された燃料制御装置が、燃料圧力が所定値となるようにポンプ装置の停止・駆動を制御することにより、戻し管を省略しリターンレス方式を実現するものである。

【０００７】

【発明が解決しようとする課題】しかしながら、上記公知技術には、以下の課題が存在する。すなわち、公知技術①においては、燃圧調整弁はエンジンが搭載される車体前部に配置されることとなり、一方タンクは安全性確保の点から車体後部にあるので、両者を結ぶ戻し管が長大化し、省スペース化・省コスト化を図るのが困難であった。

【０００８】また、公知技術②においては、ポンプ装置と燃圧調整弁とが比較的近接して配置されるので、戻し管の長さがきわめて短くなり（実質的になくなり）リターンレス方式を実現できるが、一方で参照圧導入管を設ける場合にはその長さが長くなるので、戻し管短縮化・省略化の効果が減殺される。また、参照圧導入管の長さが長くなることは、エンジンの運転状態の伝達遅れが生じるので、運転状態変化時に運転性や排気ガス状態を悪

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化させる。さらに、燃圧調整弁がタンク近傍に取り付けられることによって燃圧調整弁と燃料噴射弁との距離が長くなるので、燃料噴射弁近傍での燃料圧力変動が大きくなり、高精度の燃料供給制御ができなくなる。また、エンジン停止後の温度上昇時にも溢流の開弁圧が一定であるので、燃料から気泡が発生してエンジンの再始動性を悪化させる。

【０００９】さらに、公知技術①及び②において、ポンプ装置は常に全量吐出状態であって、このポンプ装置から送出された燃料流量のうち、燃料噴射弁から噴射された燃料流量を差し引いた分が燃圧調整弁からの溢流流量としてタンクへと循環する構成である。したがって例えば低速運転時には燃料の流量ロスが生じるとともに、ポンプの無駄な運転を抑制し消費動力の削減を図ることができなかった。また例えばアイドル運転時には上記した溢流流量が極めて大きくなってタンク循環量が増加するので、タンク内の燃料温度上昇を招く場合がある。よってこれにより燃料ベーパの発生量が多くなり、燃料ベーパ対策用キャニスタ装置への負担が大きくなる。またこの燃料循環量を少なくして流量ロスを解消するべく、燃料噴射弁に与えられる制御信号から推定してポンプ装置のモータへの供給電力を制御し、これによりポンプ装置からの送出量を制御する方法もあるが、制御における精度が不十分である。このため制御装置が高価になるという問題となった。

【００１０】さらに、公知技術③においては、燃料制御装置で、燃料圧力が第１の圧力より高くなったときにポンプを停止し、燃料圧力が第１の圧力より小さい第２の圧力より低くなったときにポンプを駆動するような制御を行うことから、燃料圧力は第１の圧力と第２の圧力との間を常に変動するので、高精度の燃料圧力制御ができずかつ制御の安定性に欠ける。

【００１１】本発明の第１の目的は、参照圧導入管の長さ及び燃圧調整弁と燃料噴射弁との距離を長くすることなく、かつ気泡発生を抑制しつつ、高精度で安定的な燃料圧力制御が可能なリターンレス方式の燃料供給装置及びこれに用いる燃圧調整弁を提供することである。

【００１２】本発明の第２の目的は、ポンプの流量ロス及び消費動力の削減を安価に図ることができる燃料供給装置を提供することである。

【００１３】

【課題を解決するための手段】上記第１の目的を達成するために、本発明によれば、燃料が貯留される燃料タンクと、この燃料タンク内の燃料を加圧し吐出する燃料ポンプ及びこの燃料ポンプの吐出圧を第１の所定値に制限する吐出圧保持手段を備えた燃料ポンプ装置と、上流側一端が前記燃料ポンプ装置に接続された燃料供給管と、この燃料供給管の下流側一端にそれぞれ接続され前記燃料供給管から導かれた燃料をエンジンの吸気管内に噴射する少なくとも１つの燃料噴射弁と、前記燃料噴射弁の

噴射部近傍の参照圧力を導く参照圧導入管と、この参照圧導入管に接続され前記燃料供給管内の燃料圧力を調整する燃圧調整弁とを有する燃料供給装置において、前記燃圧調整弁は、前記燃料供給管上に設けられており、該燃料供給管のうち該燃圧調整弁より上流側部分の圧力を第１の所定値以下に保持するとともに、該燃料供給管のうち該燃圧調整弁より下流側部分の圧力が第１の所定値より小さい第２の所定値よりも小さくなると、前記上流側部分の燃料を前記下流側部分に流入させ該下流側部分の圧力を前記第２の所定値に保持することを特徴とする燃料供給装置が提供される。

【００１４】好ましくは、前記燃料供給装置において、前記燃圧調整弁は、該燃料供給管のうち該燃圧調整弁より下流側部分の圧力と前記参照圧との差圧が所定差圧より小さくなると、上流側部分の燃料を下流側部分に流入させて前記下流側部分の圧力を前記参照圧から所定差圧だけ大きくなるように保持することを特徴とする燃料供給装置が提供される。

【００１５】また好ましくは、前記燃料供給装置において、前記燃料ポンプ装置は、前記燃料ポンプから前記燃料供給管方向への流れのみを許容する逆止弁をさらに有することを特徴とする燃料供給装置が提供される。

【００１６】さらに好ましくは、前記燃料供給装置において、前記燃圧調整弁は、ケーシングと、ケーシング内部を参照圧室と調圧室とに区分するように設けられ前記参照圧室内の圧力と前記調圧室内の圧力との大小に応じて変形可能なダイヤフラムと、前記ケーシングの前記参照圧室側に固定され前記参照圧導入管が接続される参照圧接続口と、前記ケーシングの前記調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より下流側部分が接続される調圧燃料吐出口と、前記ケーシングの調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より上流側部分が接続される供給燃料接続口と、この供給燃料接続口に形成され該供給燃料接続口内部と外部とを連通する第１の孔と、前記調圧室内に配置され前記ダイヤフラムの変形に応じて該ダイヤフラムの変形方向に移動可能な可動バルブと、この可動バルブに形成され前記調圧室内の圧力と前記参照圧室内の圧力との差圧が前記所定差圧より小さくなると前記第１の孔と前記調圧室とを連通する第２の孔とを有することを特徴とする燃料供給装置が提供される。

【００１７】また好ましくは、前記燃料供給装置において、前記吐出圧保持手段は、前記燃料ポンプの吐出側管路から分岐して接続されたリリーフ弁を備えていることを特徴とする燃料供給装置が提供される。

【００１８】さらに上記第１及び第２の目的を達成するために、好ましくは、前記燃料供給装置において、前記燃料供給管のうち該燃圧調整弁より上流側部分の圧力を検出し対応する検出信号を出力する圧力検出手段と、前記検出信号に応じ前記上流側部分の圧力が、前記第１の所定値より小さくかつ前記第２の所定値より大きい範囲にある第３の所定値になるように該燃料ポンプの駆動を制御するポンプ制御手段とをさらに有することを特徴とする燃料供給装置が提供される。

【００１９】また上記第１の目的を達成するために、本発明によれば、エンジンの吸気管内に燃料を噴射する燃料噴射弁の噴射部近傍の参照圧力を導く参照圧導入管に接続され、前記燃料噴射弁に燃料を導く燃料供給管内の燃料圧力を調整する燃圧調整弁において、ケーシングと、ケーシング内部を参照圧室と調圧室とに区分するように設けられ前記参照圧室内の圧力と前記調圧室内の圧力との大小に応じて変形可能なダイヤフラムと、前記ケーシングの前記参照圧室側に固定され前記参照圧導入管が接続される参照圧接続口と、前記ケーシングの前記調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より下流側部分が接続される調圧燃料吐出口と、前記ケーシングの調圧室側に固定され前記燃料供給管のうち該燃圧調整弁より上流側部分が接続される供給燃料接続口と、この供給燃料接続口に形成され該供給燃料接続口内部と外部とを連通する第１の孔と、前記調圧室内に配置され前記ダイヤフラムの変形に応じて該ダイヤフラムの変形方向に移動可能な可動バルブと、この可動バルブに形成され前記調圧室内の圧力と前記参照圧室内の圧力との差圧が第１の所定差圧より小さくなると前記第１の孔と前記調圧室とを連通する第２の孔とを有することを特徴とする燃料調圧弁が提供される。

【００２０】好ましくは、前記燃料調圧弁において、前記可動バルブは、内周の少なくとも一部分が前記供給燃料接続口の外周に接して設けられ、前記ダイヤフラムの変形に応じ該供給燃料接続口の軸方向に摺動することを特徴とする燃料調圧弁が提供される。

【００２１】また好ましくは、前記燃料調圧弁において、前記参照圧室内に配置され、一端が前記ダイヤフラムに当接し該ダイヤフラムを前記第１の所定差圧に等しい大きさの付勢力で前記調圧燃料吐出口側に向かって付勢するバネを有することを特徴とする燃料調圧弁が提供される。

【００２２】さらに好ましくは、前記燃料調圧弁において、前記可動バルブは、前記調圧室内の圧力と前記参照圧室内の圧力との差圧が、前記第１の所定差圧よりも大きな第２の所定差圧より小さくなると前記第１の孔と前記調圧室とを連通する開口部分を有することを特徴とする燃料調圧弁が提供される。

【００２３】

【作用】以上のように構成した本発明においては、燃料ポンプ装置に備えられた燃料ポンプで吐出されるとともに吐出圧保持手段で圧力が第１の所定値に保持された燃料が燃料供給管を介し燃料噴射弁に導かれ、この燃料が燃料噴射弁によってエンジンの吸気管内に噴射される。そして燃料供給管内の燃料圧力は、参照圧導入管を介し

燃料噴射弁近傍の参照圧力が導かれている燃圧調整弁によって調整される。このとき、この燃圧調整弁が、燃料供給管上に設けられ、下流側部分の圧力が第２の所定値よりも小さくなると、上流側部分の燃料を下流側部分に流入させて下流側圧力を第２の所定値に保持する流入制御形燃圧調整弁であることにより、従来の溢流制御形燃圧調整弁のような燃料戻し管は完全に不要となるので、リターンレス方式でありながら燃圧調整弁を燃料噴射弁の近傍に配置し、参照圧導入管を短くすることができる。また、燃圧調整弁が、下流側部分の圧力が小さくなると上流側部分の燃料を下流側部分に流入させる流入制御形燃圧調整弁であることにより、エンジン運転終了後に予熱で下流側の燃料が高温となった場合でも、燃圧調整弁は開弁して連通せず下流側を高圧に維持する。すなわち従来のように燃圧調整弁が容易に開弁して燃料供給管内が低圧となることがないので、温度上昇による気泡の発生が抑制される。さらに、燃圧調整弁の下流側部分の圧力は第２の所定値に一意的に決定されるので、燃料制御装置でポンプの駆動・停止を行う従来のように圧力が変動することがなく、高精度で安定的な燃料圧力制御を行うことができる。

【００２４】また、燃圧調整弁は、燃料供給管のうち燃圧調整弁より下流側部分の圧力と参照圧との差圧が所定差圧より小さくなると、上流側部分の燃料を下流側部分に流入させて下流側部分の圧力を参照圧から所定差圧だけ大きくなるように保持することにより、供給燃料圧と燃料噴射弁噴射部との相対圧を一定にする機能を実現することができる。さらに、燃料ポンプ装置に、燃料ポンプから燃料供給管方向への流れのみを許容する逆止弁がさらに設けられていることにより、エンジン運転終了後に予熱で下流側の燃料が高温となり、燃圧調整弁は開弁せず下流側を高圧に維持しているとき、上流側も逆止弁によって燃料ポンプ方向への逆流が阻止されて高圧となるので、従来のように管内が低圧となることがない。すなわち、上流側も温度上昇による気泡の発生が抑制される。また、燃圧調整弁は、ケーシングと、ケーシング内部を参照圧室と調圧室とに区分するように設けられ参照圧室内の圧力と調圧室内の圧力との大小に応じて変形可能なダイヤフラムと、ケーシングの参照圧室側に固定され参照圧導入管が接続される参照圧接続口と、ケーシングの調圧室側に固定され燃料供給管のうち燃圧調整弁より下流側部分が接続される調圧燃料吐出口と、ケーシングの調圧室側に固定され燃料供給管のうち燃圧調整弁より上流側部分が接続される供給燃料接続口と、この供給燃料接続口に形成され供給燃料接続口内部と外部とを連通する第１の孔と、調圧室内に配置されダイヤフラムの変形に応じてダイヤフラムの変形方向に移動可能な可動バルブと、この可動バルブに形成され調圧室内の圧力と参照圧室内の圧力との差圧が所定差圧より小さくなると第１の孔と調圧室とを連通する第２の孔とを有する。これにより、燃料供給管の下流側部分における圧力が小さくなって、調圧室内の圧力と参照圧室内の圧力との差圧が小さくなると、ダイヤフラムが調圧室側に変形し、これに応じて可動バルブが調圧室側に移動する。そしてさらに調圧室内の圧力と参照圧室内の圧力との差圧が小さくなりこの値が第１の所定差圧より小さくなると、さらに可動バルブが調圧室側に移動し、供給燃料接続口の第１の孔と調圧室とが可動バルブの第２の孔を介し連通するので、第１の孔及び第２の孔を介し、燃料供給管の上流側部分の燃料を下流側部分に流入させて下流側部分の圧力を参照圧から所定差圧だけ小さくなるように保持することができる。さらに、吐出圧保持手段は、燃料ポンプの吐出側管路から分岐して接続されたリリーフ弁を備えていることにより、ポンプ吐出圧を第１の所定値に保持する手段を実現できる。また、燃料供給管のうち燃圧調整弁より上流側部分の圧力を検出し対応する検出信号を出力する圧力検出手段と、検出信号に応じ上流側部分の圧力が、第１の所定値より小さくかつ第２の所定値より大きい範囲にある第３の所定値になるように燃料ポンプの駆動を制御するポンプ制御手段とを備える。このとき、燃料供給管の下流側部分は第２の所定値に、上流側部分は第１の所定値より小さく第２の所定値より大きな第３の所定値に保たれることから、燃料噴射弁への必要燃料流量の大小に応じ、自動的に燃料ポンプの駆動がポンプ制御手段で制御されることになる。すなわち高速運転時には燃料噴射弁には大量の燃料流量が必要となり、下流側部分の燃料が急速に燃料噴射弁に供給されて下流側部分の圧力が急速に下がろうとするが、燃圧調整弁のはたらきで上流側部分から下流側部分へと燃料が供給されて下流側部分の圧力が第２の所定値に維持され、またこれにより上流側部分の圧力が急速に下がろうとするが、その急速な低下に応じて燃料ポンプが制御され高回転で駆動し上流側部分の圧力低下を防止して第３の所定値に維持する。逆に、低速運転時には燃料噴射弁に必要な燃料流量は少量で足り、下流側部分の燃料はあまり燃料噴射弁に供給されず下流側部分の圧力はあまり下がらないので、上流側部分から下流側部分へと燃料はあまり供給されず上流側部分の圧力はゆっくりと下がろうとする。よって、この緩慢な低下に応じ燃料ポンプが制御され低回転で駆動することになる。このようにして必要燃料流量及び圧力に応じた高精度のフィードバック制御を簡単に行うことができる。すなわちこのときの第３の所定値を第２の所定値より大きくすることにより第２の所定値より大きい分下流側部分へ流入するための差圧を確保することができる。また、第３の所定値をもし第１の所定値より大きくすると、燃料供給管の圧力はポンプ吐出圧保持手段でもともと第１の所定値に保持されていることから、ポンプがどんな駆動をしても第３の所定値には至らずに制御できず、また第１の所定値に等しくすると常に第３の所定値に達していることとなり、制御する

意味がない。しかし本発明では第３の所定値を第１の所定値より小さく設定することにより上記の制御を有効に行い、そして第３の所定値が第１の所定値より小さい分、ポンプ流量ロス及びポンプ消費動力の削減を図ることができる。

【００２５】さらに、本発明の燃料調圧弁においては、可動バルブは、内周の少なくとも一部分が供給燃料接続口の外周に接して設けられ、ダイヤフラムの変形に応じ供給燃料接続口の軸方向に摺動することにより、調圧室内に配置されてダイヤフラムの変形方向に移動可能な構成を実現できる。また、参照圧室内に配置され、一端がダイヤフラムに当接しダイヤフラムを第１の所定差圧に等しい大きさの付勢力で調圧燃料吐出口側に向かって付勢するバネを有することにより、第１の所定差圧を与える手段を実現できる。さらに、可動バルブは、調圧室内の圧力と参照圧室内の圧力との差圧が、第１の所定差圧よりも大きな第２の所定差圧より小さくなると第１の孔と調圧室とを連通する開口部分を有することにより、エンジン運転終了後の予熱で燃料温度が上昇して下流側の圧力が第２の所定差圧になると、第１の孔及び開口部分を介し調圧室と上流部分が連通して下流側の燃料が上流側に流出するので、調圧室内の過度の圧力上昇を防止することができる。

【００２６】

【実施例】以下、本発明の実施例を図１～図６により説明する。本発明の第１の実施例を図１～図４により説明する。本実施例は、燃料供給装置についての実施例である。本実施例による燃料供給装置の全体構成を表す概念図を図１に示す。図１において、本実施例の燃料供給装置１００は、通常は安全性確保のため自動車の後部に設けられて燃料が貯留されるタンク１と、図示しないモータによって駆動されタンク１内の燃料を吸引加圧し吐出するポンプ２Ａ、ポンプ２Ａと直列に接続され吐出した燃料の逆流を防止するチェック弁２Ｂ、及びポンプ２Ａの吐出圧を第１の所定値（後述）に保持する吐出圧保持手段、例えばポンプ２ａの吐出側管路から分岐して接続されたリリーフ弁２Ｃを備えたポンプ装置２と、上流側一端がポンプ装置２に接続された燃料供給管３と、この燃料供給管３の下流側一端にそれぞれ接続され燃料供給管３から導かれた燃料を図示しないエンジンの吸気管内に噴射する少なくとも１つ、図示実施例では４つの燃料噴射弁９と、燃料噴射弁９の噴射部近傍の参照圧力、例えば図示しないインテークマニホールドコレクタ部の圧力を導く参照圧導入管６と、燃料供給管３上に設けられるとともに参照圧導入管６に接続され、燃料供給管３内の燃料圧力を調整する燃圧調整弁４とを有する。

【００２７】リリーフ弁２Ｃは、ポンプ２Ａと並列に接続されており、供給圧力の過度の上昇が生じたときに内部の通路を開き、燃料をタンク１に逃がして圧力を第１の所定値に保つ。燃料噴射弁９は、例えば、エンジンの吸気管のインテークマニホールド部に取り付けられており、図示しない電子的な制御装置からの開弁制御信号が加えられて、この制御信号によって燃料噴射弁９からエンジンに噴射される燃料噴射量が決定される。

【００２８】燃圧調整弁４は、参照圧導入管６に接続され燃料噴射弁９に燃料を導く燃料供給管３内の燃料圧力を調整するものであり、後述する図５に示されるように、ケーシング４２内部を参照圧室５１と調圧室５２とに区分するダイヤフラム３６と、参照圧導入管６が接続される参照圧接続口４４と、燃料供給管３のうち燃圧調整弁４より下流側供給管３ｂが接続される調圧燃料吐出口４６と、燃料供給管３のうち燃圧調整弁４より上流側供給管３ａが接続される供給燃料接続口２２と、供給燃料接続口２２内部の縦孔２５と外周溝２４とを連通する横孔２３と、ダイヤフラム３６の変形に応じてダイヤフラム３６の変形方向（図示上下方向）に移動可能な可動バルブ２６と、この可動バルブ２６に形成された横孔３０と、一端がダイヤフラム３６に当接しダイヤフラム３６を調圧燃料吐出口側に向かって付勢するメインスプリング４１とを有する。このような構成によって、燃料供給管３の下流側供給管３ｂの圧力と参照圧導入管６を介し導かれた参照圧との差圧が所定差圧より小さくなると、上流側供給管３ａの燃料を下流側供給管３ｂに流入させ、下流側供給管３ｂの圧力が参照圧より所定差圧だけ大きくなるように保持するとともに、燃料供給管３の上流側供給管３ａの圧力をリリーフ弁２Ｃであらかじめ設定された第１の所定値に保持する機能を備えている。なおこのときの第１の所定値は下流側供給管３ｂの圧力より常に大きくなるようにあらかじめ設定されている。

【００２９】次に、上記のように構成した本実施例による燃料供給装置１００の作用を説明する。本実施例の第１の比較例による燃料供給装置１５０を図２に示す。本比較例は、リターンレス方式でない従来の燃料供給装置の比較例である。本実施例の燃料供給装置１００と同等の部材には同一の符号を付す。図２において、本比較例の燃料供給装置１５０が本実施例の燃料供給装置１００と異なる主要な点は、燃圧調整弁５が、例えば特開平５－３２１７９２号公報等に示されているような溢流制御形の燃圧調整弁であって、内部に設けられた図示しない調圧スプリング及び参照圧導入管６が導いた参照圧の作用により、燃料噴射弁９に導かれる燃料圧力と燃料噴射弁９の噴射部における圧力との差圧が一定になるような圧力で内部弁を開く機能を有することと、この燃圧調整弁５からの余剰分の溢流燃料は燃料戻し管８を介しタンク１に戻されることと、この燃圧調整弁５が燃料供給管３上でなく燃料供給管３から分岐した分岐配管７に設けられていることである。その他の構成は、第１の実施例の燃料供給装置１００とほぼ同様である。

【００３０】以上の構成において、燃圧調整弁５がエンジンが搭載される車体前部に配置される一方、タンク１

は安全性確保の点から車体後部にあるのが通常であるので、両者を結ぶ燃料戻し管８が長大化し、省スペース化・省コスト化を図るのが困難であった。

【００３１】これに対し、本実施例の燃料供給装置１００においては、燃圧調整弁４は、燃料供給管３上に設けられ、下流側供給管３ｂの圧力が小さくなると上流側供給管３ａの燃料を下流側供給管３ｂに流入させる流入制御形燃圧調整弁であることにより、上記従来の溢流制御形の燃圧調整弁５のような燃料戻し管は完全に不要となる。よって、省スペース化・省コスト化を図ることができる。本実施例の第２の比較例による燃料供給装置１７０を図３に示す。本比較例は、リターンレス方式を採用している従来の燃料供給装置である。本実施例の燃料供給装置１００及び第１の比較例の燃料供給装置１５０と同等の部材には同一の符号を付す。図３において、本比較例の燃料供給装置１７０が上記第１の比較例の燃料供給装置１５０と異なる主要な点は、溢流制御形の燃圧調整弁５が設けられる分岐配管７が、ポンプ装置２の比較的近傍において燃料供給管３から分岐しており、これによって、燃料戻し管８の長さが極めて短くなっていることである。その他の構成は、第１の比較例の燃料供給装置１５０とほぼ同様である。

【００３２】以上の構成においては、ポンプ装置２と燃圧調整弁５とが比較的近接して配置されることによって燃料戻し管８の長さがきわめて短くなり（実質的になくなり）いわゆるリターンレス方式を実現できるが、一方で参照圧導入管６の長さが長くなるので、燃料戻し管８の短縮化・省略化の効果が減殺される。また、参照圧導入管６の長さが長くなることは、エンジンの運転状態の伝達遅れが生じるので、運転状態変化時に運転性や排気ガス状態を悪化させる。さらに、燃圧調整弁５がタンク１近傍に取り付けられることによって燃圧調整弁５と燃料噴射弁９との距離が長くなるので、燃料噴射弁９近傍での燃料圧力変動が大きくなり、高精度の燃料供給制御ができなくなる。また、燃料噴射弁９はエンジンの熱を受けており、運転時には通過する燃料、マニホールド内部を流れる機関冷却水、冷却風等によって冷却され、５０℃程度と比較的低い温度に保たれている。しかしエンジン停止後は、前述の冷却効果が全てなくなってより高温の排気部分の熱が伝わるので、運転状態にもよるが、エンジン停止後１０分～１５分経過後で、燃料噴射弁９近傍の温度が例えば１００℃を超える場合がある。このような状態において、燃料供給管３内の燃料が昇温膨張して圧力も上昇しようとする。ここで、燃圧調整弁５は、燃料供給管３内の圧力と参照圧導入配管６から導かれる参照圧力との差圧をある一定差圧にするように開弁を行って溢流制御を行うが、エンジン停止時における参照圧力は大気圧であるので、燃料供給管３内の圧力が大気圧＋一定差圧の値を超えると、燃圧調整弁５は容易に開弁して溢流を開始するので、燃料圧力の上昇が起こらない。したがって、燃料供給管３内に燃料の気泡が発生し、エンジンの再始動性を悪化させる問題が生ずる。

【００３３】また、燃圧調整弁５は溢流制御形であることから、ポンプ装置２は常にほぼ全量吐出状態に維持される一方、ポンプ装置２から送出された燃料流量のうち燃料噴射弁９から噴射された燃料流量を差し引いた分が溢流流量としてタンク１へと循環する構成であるので、例えば低速運転時には溢流流量が大量に生じタンク１内の燃料の循環量を多くするのでタンク１内の燃料温度上昇を招き、燃料ベーパの発生量を多くして、図示しない燃料ベーパ対策用キャニスタ装置への負担を大きくするという問題を発生する。ここで、これに応じてこのタンク１内燃料循環量を少なくするためにポンプ装置２からの送出量を制御することが考えられるが、燃料供給管３内の燃料圧力は燃圧調整弁５の溢流圧力にほぼ等しくなるのでこれを選択的に制御する余地はない。あるいは例えば燃料噴射弁９に与えられる制御信号から推定し、図示しないポンプ用モータへの供給電力を制御する方法もあるが、この場合は充分高い精度の制御とはならない。

【００３４】これに対して、本実施例の燃料供給装置１００においては、燃圧調整弁４は、燃料供給管３上に設けられ、下流側供給管３ｂの圧力と参照圧との差圧が所定差圧より小さくなると上流側供給管３ａの燃料を下流側供給管３ｂに流入させる流入制御形燃圧調整弁であることにより、上記従来の溢流制御形の燃圧調整弁５のような燃料戻し管は完全に不要となるので、リターンレス方式でありながら燃圧調整弁４を燃料噴射弁９の近傍に配置し、参照圧導入管６を短くすることができる。すなわち、燃圧調整弁４と燃料噴射弁９との距離が短くなるので燃料噴射弁９近傍の圧力変動を小さくすることができ、また参照圧導入管６が短くなるので、エンジン運転状態の変化への応答性を向上させることができる。また、燃圧調整弁４が、下流側供給管３ｂの圧力が小さくなると上流側供給管３ａの燃料を下流側供給管３ｂに流入させる流入制御形燃圧調整弁であることにより、エンジン運転終了後に予熱で下流側供給管３ｂの燃料が高温となった場合でも、燃圧調整弁４は開弁して連通せず下流側供給管３ｂを高圧に維持する。そしてこのとき、ポンプ装置２にポンプ２Ａから燃料供給管３方向への流れのみを許容するチェック弁２Ｂがさらに設けられていることにより、上流側供給管３ａもチェック弁２Ｂでポンプ２Ａ方向への逆流が阻止されて高圧に維持される。よって従来のように燃圧調整弁が容易に開弁して燃料供給管内が低圧となることがないので、温度上昇による気泡の発生が抑制される。よってエンジンの再始動性に優れた燃料供給装置を提供することができる。また、燃料供給管３の下流側供給管３ｂの圧力は、参照圧から所定差圧だけ大きくなるように一意的に決定されるので、燃料制御装置でポンプの駆動・停止を繰り返して燃料圧力を一定範囲に制御する従来のように圧力が変動することが

なく、高精度で安定的な燃料圧力制御を行うことができる。また、流入制御形燃圧調整弁であることにより、タンク２Ｃへの燃料循環量はリリーフ弁２Ｃでリリーフされたものだけとなって循環量が低減するので、タンク１内の燃料温度の上昇を防止することができる。

【００３５】本発明の第２の実施例を図４により説明する。本実施例も、第１の実施例と同様燃料供給装置についての実施例である。本実施例による燃料供給装置２００の全体構成を表す概念図を図４に示す。第１の実施例と同等の部材には同一の符号を付す。図４において、本実施例の燃料供給装置２００が第１の実施例の燃料供給装置１００と異なる主要な点は、燃料供給管３の上流側供給管３ａの圧力を検出し対応する検出信号に変換して出力する圧力検出手段、例えばプレッシャセンサ１０と、このプレッシャセンサ１０からの検出信号が入力されてこれに応じて出力線１３を介し図示しないポンプ駆動モータを制御するポンプ制御手段、例えば電子制御装置１１とを備えていることである。ここで電子制御装置１１内の図示しない制御ソフトウェア中には、第１の実施例で前述した第１の所定値より小さくかつ第２の所定値より大きい範囲にある第３の所定値があらかじめ設定されており、プレッシャセンサ１０からの信号は、電子制御装置１１中の図示しないアナログ／デジタル変換装置を介し制御ソフトウェアに入力され、この制御ソフトウェアにおいて第３の所定値と比較され、上流側供給管３ａの圧力がこの第３の所定値となるようにポンプ２を駆動する駆動信号が出力線１３を介して出力される。なおこの電子制御装置１１は、燃料噴射弁９に図示しない開弁時間信号を与えて一義的にエンジンへの燃料供給量を決定する電子制御装置と兼用することもできる。上記した第３の所定値は、任意に設定される１つの設定値とするか、機関の運転状態に応じて定められる１つの設定値とするか、あるいは前記した範囲において変動可能な値等に選定することができる。この第３の所定値は必ずしも常時必要ではなく、いわばポンプがある程度以上の能力で運転する時にのみ必要である。すなわち、下流側供給管３ｂが必要とする圧力以上であれば原理的には燃料供給装置の機能は成立することになる。なお、この第３の所定値として何も設定しない場合には、下流側供給管３ｂの圧力は自動的にポンプ装置２のリリーフ圧力となる。

【００３６】上記構成の燃料供給装置２００においては、燃料供給管３の上流側供給管３ａの圧力を検出し対応する検出信号を出力するプレッシャセンサ１０と、検出信号に応じ上流側供給管３ａの圧力が、第１の所定値より小さくかつ第２の所定値より大きい範囲にある第３の所定値になるようにポンプ２Ａの駆動を制御する電子制御装置１１とを備える。このとき、下流側供給管３ｂの圧力は前述した第２の所定値に、上流側供給管３ａの圧力は第３の所定値に保たれることから、燃料噴射弁９への必要燃料流量の大小に応じ、自動的にポンプ２Ａの駆動が電子制御装置１１で制御されることになる。すなわち高速運転時には燃料噴射弁９には大量の燃料流量が必要となり、下流側供給管３ｂの燃料が急速に燃料噴射弁９に供給されて下流側供給管３ｂの圧力が急速に下がろうとするが、燃圧調整弁５のはたらきで上流側供給管３ａから下流側供給管３ｂへと燃料が供給されて下流側供給管３ｂの圧力が第２の所定値に維持され、またこれにより上流側供給管３ａの圧力が急速に下がろうとするが、その急速な低下に応じてポンプ２Ａが制御され高回転で駆動し上流側供給管３ａの圧力低下を防止して第３の所定値に維持する。逆に、低速運転時には燃料噴射弁９に必要な燃料流量は少量で足り、下流側供給管３ｂの燃料はあまり燃料噴射弁９に供給されず下流側供給管３ｂの圧力はあまり下がらないので、上流側供給管３ａから下流側供給管３ｂへと燃料はあまり供給されず上流側供給管３ａの圧力はゆっくりと下がろうとする。よって、この緩慢な低下に応じポンプ２Ａが制御され低回転で駆動することになる。このようにして必要燃料流量及び圧力に応じた高精度のフィードバック制御を簡単に行うことができる。すなわちこのときの第３の所定値を第２の所定値より大きくすることによって第２の所定値より大きい分下流側供給管３ｂへ流入するための差圧を確保することができる。また、第３の所定値をもし第１の所定値より大きくすると、燃料供給管３の圧力はリリーフバルブ２Ｃでもともと第１の所定値に保持されていることから、ポンプ２Ａがどんな駆動をしても第３の所定値には至らず制御できない。また第１の所定値に等しくすると常に第３の所定値に達していることとなり、制御する意味がない。しかし本実施例では第３の所定値を第１の所定値より小さく設定することにより、上記の制御を有効に行い、そして第３の所定値が第１の所定値より小さい分、ポンプ流量ロス及びポンプ消費動力の削減を図ることができる。

【００３７】なお、上記構成においては、プレッシャセンサ１０及び電子制御装置１１と、ポンプ装置２に備えられたリリーフ弁２Ｃ（図１参照）との両方を設けたが、リリーフ弁２Ｃを省略することもでき、この場合は、プレッシャセンサ１０及び電子制御装置１１が吐出圧保持手段を構成することになる。また、プレッシャセンサ１０は、圧力値を連続的な電気信号に変換するものではなく特定圧力値でスイッチング動作するようなものであり、例えばこのスイッチ信号が所定の時間間隔で断続されるように駆動信号を制御する構成でもよい。この場合も同様の効果を得る。さらに、出力線１３からの駆動信号は、既知の方法で、例えば電流値を連続的に変化させた駆動信号や、単純にポンプを断続する駆動信号や、あるいはデューティ変化によって実質駆動電流値が制御された駆動信号等に選定することも可能である。この場合も同様の効果を得る。

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【００３８】本発明の第３の実施例を図５及び図６により説明する。本実施例は、第１及び第２の実施例の燃料供給装置１００，２００において用いられる燃圧調整弁の実施例である。第１及び第２の実施例と同等の部材には同一の符号を付す。本実施例の燃圧調整弁４の構成を表す縦断面図を図５に示す。図５において、燃圧調整弁４は、例えば図示しないエンジンの吸気管内に燃料を噴射する燃料噴射弁９の噴射部近傍の参照圧力を導く参照圧導入管６に接続され、燃料噴射弁９に燃料を導く燃料供給管３（以上図１及び図４参照）内の燃料圧力を調整するものであり、上部ケーシング４２Ｕ及び下部ケーシング４２Ｌからなるケーシング４２と、ケーシング４２内部を、図示上方に配置される参照圧室５１と図示下方に配置され供給燃料の圧力を調整する調圧室５２とに区分するダイヤフラム３６と、上部ケーシング４２Ｕに気密に固定され参照圧導入管６が接続される参照圧接続口４４と、下部ケーシング４２Ｌに油密に固定され燃料供給管３の下流側供給管３ｂ（図１及び図４参照）が接続される調圧燃料吐出口４６と、下部ケーシング４２Ｌに固定され燃料供給管３の上流側供給管３ａが接続される供給燃料接続口２２と、この供給燃料接続口２２に形成され供給燃料接続口２２内部の縦孔２５と外周に形成された外周溝２４とを連通する少なくとも１個の横孔２３と、調圧室５２内に配置されダイヤフラム３６の変形（後述）に応じてダイヤフラム３６の変形方向（図示上下方向）に移動可能な可動バルブ２６と、可動バルブ２６を保持するとともにダイヤフラム３６の変形移動を可動バルブ２６へ伝達するバルブホルダ３４と、可動バルブ２６に形成された横孔３０と、参照圧室５１内に配置されて一端がダイヤフラム３６に当接しダイヤフラム３６を調圧燃料吐出口側（図示下方向）に向かって付勢するメインスプリング４１とを有する。

【００３９】ダイヤフラム３６は、バルブホルダ３４の軸方向ほぼ中央部においてスプリングリテーナ３７との間に挟み込まれ、バルブホルダ３４の段部３８がかしめられることにより保持されており、受圧部材として、参照圧室５１内の圧力と調圧室５２内の圧力との大小に応じて変形可能となっている。また、ダイヤフラム３６の上部にはダイヤフラム３６の上部への変形移動を案内するダイヤフラムガイド４０が設けられており、このダイヤフラムガイド４０と、ダイヤフラム３６と、下部ケーシング４２Ｌの上端部が、上部ケーシング４２Ｕの下端部をかしめることによって固定されている。バルブホルダ３４の上部はストッパ部３９として伸びており、必要により上部ケーシング４２Ｕに当接しバルブホルダ３４及び可動バルブ２６の過度の上部への移動を制限可能となっている。メインスプリング４１は、上部ケーシング４２Ｕとスプリングリテーナ３７との間に挟持されており、その付勢力は第１の所定差圧に等しく、また上部ケーシング４２Ｕの肩部４３を適当に変形させることによって付勢力が微調整される。

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【００４０】可動バルブ２６は、小径の頚部３１上端のバルブ端部３３にバルブホルダ３４のカシメ部３５によって保持された押さえ板３２がはめ込まれ、バルブ端部３３においてこの押さえ板により図示下方から接触されるとともに、バルブホルダ３４に内包されるサブスプリング４７によって図示上方から付勢力を与えられ、これらの共働によって軸方向（図示上下方向）に保持される。この押さえ板３２は図６に示したように切欠きを持つ内径部を有し、この内径の大きさは可動バルブ２６の頚部３１より大きくなっている。これにより、バルブ端部３３の図示左右方向及び奥行き方向の運動が自由となり、燃料供給接続口２２と可動バルブ２６との間に調心性が与えられている。また可動バルブ２６は、内径部分の上端部に内径拡大部２７を備えており、この内径拡大部２７の下端部がバルブエッジ部２９を形成する。そしてこのバルブエッジ部２９のさらに下方の内径部分には調圧溝４８及び少なくとも１個の横孔４９が形成されるとともに供給燃料接続口２２の外周と嵌合しており、可動バルブ２６は、ダイヤフラム３６の変形に応じ供給燃料接続口２２の軸方向（図示上下方向）に摺動可能となっている。

【００４１】上記構成における動作及び作用について説明する。

【００４２】本実施例の燃圧調整弁４における燃圧調整動作は、主としてダイヤフラム３６に上下方向から作用する力のバランスによりなされるものである。すなわち、参照圧室５１に導かれた参照圧力即ち燃料噴射弁９（図１及び図４参照）の噴射部の圧力とメインスプリング４１の付勢力とがダイヤフラム３６に対して図示下方へ作用する一方、調圧室５２内の圧力がダイヤフラム３６に対して図示上方に作用する。

【００４３】ここで例えば、燃料供給管３の下流側供給管３ｂにおける圧力が小さくなって、この圧力と実質的に等しい調圧室５２内の圧力と参照圧室６内の圧力との差圧が小さくなると、ダイヤフラム３６が調圧室５２側（図示下方）に変形し、これに応じて可動バルブ２６が調圧室５２側（図示下方）に移動する。そしてさらに調圧室５２内の圧力と参照圧室６内の圧力との差圧が小さくなってメインスプリング４１の付勢力に等しい第１の所定差圧より小さくなると、すなわち参照圧室５１内の圧力とメインスプリング４１の付勢力との合力は調圧室５２内の圧力より大きくなると、供給燃料接続口２２の横孔２３と調圧室５２とが可動バルブ２６の横孔３０を介し連通する。したがって、ポンプ装置２から送出され燃料供給管３の上流側供給管３ａから供給された燃料は、供給燃料接続口２２の縦穴２５から、横孔２３、外周溝２４、可動バルブ２６の内径拡大部２７及び横孔３０、調圧室５２、及び調圧燃料吐出口４６を介して下流側供給管３ｂに流入する。なお、可動バルブ２６の過度

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の下方への移動を規制するために、可動バルブ２６の内径拡大部２７の上端部２８を供給燃料接続口２２の外部上端部に当接させるよう構成することもできる。上記のようにして、燃料が流入し調圧室５２の圧力が上昇していくと、ダイヤフラム３６及びバルブホルダ３４、可動バルブ２６が上方に移動していく。そして調圧室５２内の圧力と参照圧室５１内の圧力との差圧がメインスプリング４１の付勢力に等しい第１の所定差圧より大きくなると、すなわち調圧室５２からダイヤフラム３６に作用する上向き力が前述した参照圧室５１内の圧力とメインスプリング４１の付勢力との合力より大きくなると、可動バルブ２６のバルブエッジ部２９が供給燃料接続口２２の外周溝２４を閉塞し、縦孔２５からの燃料が調圧室５２へ流出しなくなる。

【００４４】以上説明した動作により、下流側供給管３ｂの圧力は参照圧から所定差圧だけ大きくなるように常に保持される。すなわち、燃料噴射弁９（図１及び図４参照）に導かれる燃料圧力と、参照圧である燃料噴射弁９の噴射部における圧力との差圧が、エンジンの運転状態にかかわらず一定になるので、精度の高い燃料供給量制御が可能となる。またこのとき、燃圧調整のための制御通路は、供給燃料接続口２２の円筒外周部及び可動バルブ２６の円筒内周部で形成されており、この制御通路が横孔２３や横孔３０を介して連通しても閉じても、調圧室５２内の圧力がダイヤフラム３６に図示上向きに作用する作用面積が変わらないので、精度の高いかつ圧力変動の小さい調圧機能を得ることができる。

【００４５】また、エンジンが停止し、燃料供給管３の下流側供給管３ｂや燃料噴射弁９の部分の燃料温度が上昇すると、燃料の体積が膨張しこの部分の圧力が上昇して、調圧室５２の圧力も上昇する。これに応じて、ダイヤフラム３６、バルブホルダ３４、及び可動弁２６も上方に移動することになるが、可動弁２６においてバルブエッジ部２９から下方の閉塞部端を十分下方に配置することにより、可動弁２６が上方へ移動しても内径部が外周溝２４を閉塞したままとすることできる。これにより調圧室５２を含む下流の燃料圧力が上昇してもこれを開放せず、充分高圧のまま燃料圧力を保持するので、燃料気泡の発生が抑制されエンジンの再始動性の悪化を防止することが可能である。またさらに、この燃料の高圧状態を確実とするために、このような可動弁２６、バルブホルダ３４、及びダイヤフラム３６の上方移動時において、バルブホルダ３４のストッパ部３９を上部ケーシング４２Ｕに当接させるように寸法を決定し、これによって可動弁２６の上部への移動を規制することもできる。

【００４６】しかしながら、このときの燃料温度上昇に起因する体積膨張による圧力上昇の影響は、その体積弾性係数による圧力緩和効果よりはるかに大きく、全く体積変化をさせない場合は大きな圧力上昇となり過ぎて、配管系統を含む使用部品に過度の耐圧性を要求すること

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となる不都合が生ずる。ここにおいて、本実施例の燃圧調整弁４では、ダイヤフラム３６の径を適当に大きくとることにより、まず１次的に、調圧室５２以降の下流側における体積膨張をダイヤフラム３６の変形移動に置換することで、圧力の過度の上昇を緩和することができる。そして、それでも圧力が上昇し続けるとダイヤフラム３６及び可動バルブ２６が上方に移動するが、調圧室５２内の圧力と参照圧室５１内の圧力との差圧が、所定差圧よりも大きいある値に設定された所定差圧より大きくなると、可動バルブ２６に設けられた調圧溝４８及び横孔４９が（例えばストッパ部３９が上部ケーシング４３に当接する前に）供給燃料接続口２２に設けられた横孔２３及び調圧溝２４に開口し、これら横孔２３及び調圧溝２４と調圧室５２とを連通する。これにより、調圧室５２以降の下流側の燃料は、横孔４９、調圧溝４８、外周溝２４、及び縦孔２５を介して、燃料供給管３の上流側供給管３ａへと流入するので、燃料を内包する容積が大きくなって過度の圧力上昇を防止することができる。よって、燃圧調整弁４及び燃料供給装置１００，２００（図１及び図４参照）の安全性を向上することができる。

【００４７】なお、上記においては、可動バルブ２６の下部に設けた横孔４９及び調圧溝４８を介し高圧燃料を上流側へ逃がす構造としたが、これに限られず、図示可動バルブ２６の断面構造において、横孔４９及び調圧溝４８の位置より下方の部分を省略しても良い。この構造にすれば、調圧室５２内の圧力と参照圧室５１内の圧力との差圧が第２の所定差圧より小さくなると、可動バルブ２６の下端（この場合ほぼ図示横孔４９位置に存在することになる）が、供給燃料接続口２２の横孔２３及び調圧溝２４より上方へ移動し、すなわち横孔２３及び調圧溝２４の外周は可動バルブ２６の内周から逸脱し直接調圧室５２へ開放されることとなる。これによっても同様の効果を得る。

【００４８】

【発明の効果】本発明によれば、燃圧調整弁が、燃料供給管上に設けられ、下流側部分の圧力が第２の所定値よりも小さくなると、上流側部分の燃料を下流側部分に流入させて下流側圧力を第２の所定値に保持する流入制御形燃圧調整弁であるので、従来の溢流制御形燃圧調整弁のような燃料戻し管は完全に不要となる。よってリターンレス方式でありながら燃圧調整弁を燃料噴射弁の近傍に配置し、参照圧導入管を短くすることができる。すなわち、燃圧調整弁と燃料噴射弁との距離が短くなるので燃料噴射弁近傍の圧力変動を小さくすることができ、また参照圧導入管が短くなるので、エンジン運転状態の変化への応答性も向上させることができる。また、エンジン運転終了後に余熱で下流側の燃料が高温となった場合でも、燃圧調整弁は連通せず下流側を高圧に維持するので、温度上昇による気泡の発生が抑制され、エンジンの

再始動性に優れた燃料供給装置を提供できる。さらに、燃圧調整弁の下流側部分の圧力は第２の所定値に一意的に決定されるので、高精度で安定的な燃料圧力制御を行うことができる。またタンクへの燃料循環量を低減し、燃料タンク内燃料温度の上昇を低減することができる。また、燃料ポンプ装置に、燃料ポンプから燃料供給管方向への流れのみを許容する逆止弁がさらに設けられているので、エンジン運転終了後の燃料高温時に上流側も燃料ポンプ方向への逆流が阻止されて高圧となり、温度上昇による気泡の発生が抑制されエンジンの再始動性に優れた燃料供給装置を提供できる。さらに、調圧室内の圧力と参照圧室内の圧力との差圧が小さくなりこの値が所定差圧より小さくなると、供給燃料接続口の第１の孔と調圧室とが可動バルブの第２の孔を介し連通するので、下流側部分の圧力を参照圧から所定差圧だけ大きくなるように保持することができる。また第１の孔と調圧室とが連通してもしなくても、調圧室側からダイヤフラムに作用する力の作用面積が変わらないので、精度の高いかつ圧力変動の小さい調圧機能を得ることができる。さらに、燃料供給管のうち燃圧調整弁より上流側部分の圧力を検出し対応する検出信号を出力する圧力検出手段と、検出信号に応じ上流側部分の圧力が、第１の所定値より小さくかつ第２の所定値より大きい範囲にある第３の所定値になるように燃料ポンプの駆動を制御するポンプ制御手段とを備えるので、必要燃料流量及び圧力に応じた高精度のフィードバック制御を簡単に行うことができ、かつポンプ流量ロス及びポンプ消費動力の削減を図ることができる。

【００４９】また、本発明によれば、可動バルブは、調圧室内の圧力と参照圧室内の圧力との差圧が第１の所定差圧よりも大きな第２の所定差圧より大きくなると第１の孔と調圧室とを連通する開口部分を有するので、エンジン運転終了後の予熱で燃料温度が上昇して下流側の圧力が第２の所定差圧になると、第１の孔及び開口部分を介し調圧室と上流部分が連通して下流側の燃料が上流側に流出し、調圧室内の過度の圧力上昇を防止することができる。よって、燃圧調整弁及び燃料供給装置の安全性を向上することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施例による燃料供給装置の全体構成を示す概念図である。

【図２】第１の実施例の第１の比較例による燃料供給装置の全体構成を示す概念図である。

【図３】第１の実施例の第２の比較例による燃料供給装置の全体構成を示す概念図である。

【図４】本発明の第２の実施例による燃料供給装置の全体構成を示す概念図である。

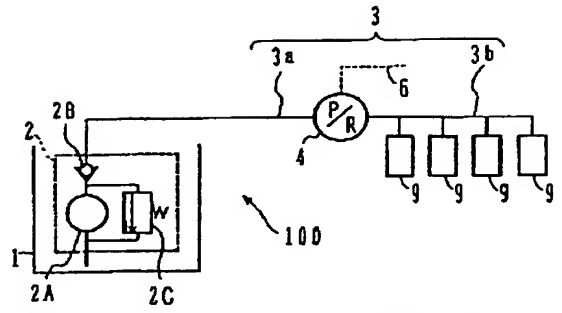
【図５】本発明の第３の実施例による燃圧調整弁の構成を示す縦断面図である。

【図６】図５中に示した押さえ板の形状を示す上面図である。

【符号の説明】

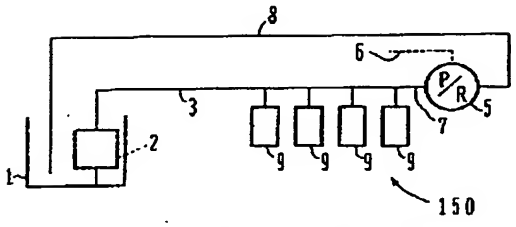
１	燃料タンク
２	ポンプ装置
２Ａ	燃料ポンプ
２Ｂ	チェック弁
２Ｃ	リリーフ弁（吐出圧保持手段）
３	燃料供給管
３ａ	上流側供給管
３ｂ	下流側供給管
４	流入制御形燃圧調整弁
５	溢流制御形燃圧調整弁
６	参照圧導入管
７	分岐配管
８	燃料戻し管
９	燃料噴射弁
１０	プレッシャセンサ（圧力検出手段）
１１	電子制御装置（ポンプ制御手段）
１３	出力線
２２	供給燃料接続口
２３	横孔（第１の孔）
２４	外周溝
２５	縦孔
２６	可動バルブ
３０	横孔（第２の孔）
３４	バルブホルダ
３６	ダイヤフラム
３７	スプリングリテーナ
３９	ストッパ部
４１	メインスプリング（バネ）
４２	ケーシング
４２Ｕ	上部ケーシング
４２Ｌ	下部ケーシング
４３	肩部
４４	参照圧接続口
４６	調圧燃料吐出口
４８	調圧溝（開口部分）
４９	横孔（開口部分）
５１	参照圧室
５２	調圧室
１００	燃料供給装置
２００	燃料供給装置

【図１】



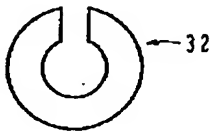
1：燃料タンク
2：ポンプ装置
2A：燃料ポンプ
2B：チェック弁
2C：リリーフ弁（吐出圧保持手段）
3：燃料供給管
3a：上流側供給管
3b：下流側供給管
4：流入制御形燃圧調整弁
6：参照圧導入管
7：分岐配管
9：燃料噴射弁
100燃料供給装置

【図２】

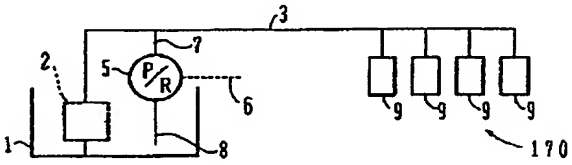


5：逆流制御形燃圧調整弁　8：燃料戻し管

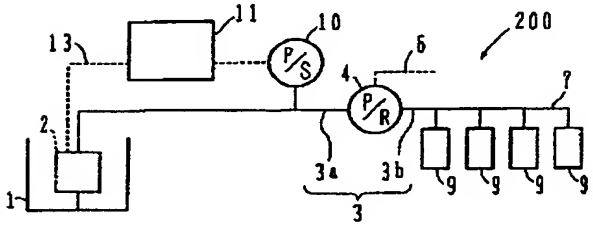
【図６】



【図３】

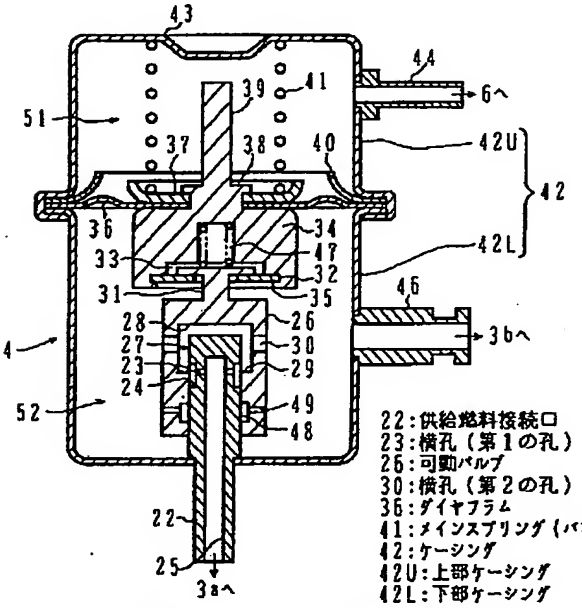


【図４】



10：プレッシャセンサ（圧力検出手段）
11：電子制御装置（ポンプ制御手段）
13：出力線
200：燃料供給装置

【図５】



22：供給燃料接続口
23：横孔（第１の孔）
26：可動バルブ
30：横孔（第２の孔）
36：ダイヤフラム
41：メインスプリング（バネ）
42：ケーシング
42U：上部ケーシング
42L：下部ケーシング
44：参照圧接続口
46：調圧燃料吐出口
48：調圧溝（開口部分）
49：横孔（開口部分）
51：参照圧室
52：調圧室

フロントページの続き

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